Supporting environmental decision-making: Anticipating bias

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Statement of Originality

This thesis is entirely the result of my own original work, except where indicated otherwise.

Fayen d'Evie

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Abstract

This thesis concerns the effectiveness of computer-based Decision Support Systems (DSS) to assist integrated environmental management (IEM). The conventional rationale for DSS, based on positivist epistemology, argues that the objectivity, expertise and efficiency of these systems frames an indispensable role for DSS in enabling stakeholders to cope with the demands of modern environmental decision-making.

Drawing on theory of the construction of knowledge, this thesis challenges the purported objectivity of DSS, and argues that bias is an inescapable feature of DSS. Bias implies that the use of the technology systematically promotes (elements of) one perspective over another, either because the output of the technology systematically promotes one perspective over another, or because use of the technology limits the opportunities of certain actors to participate in environmental decision-making. A taxonomy of bias relevant to environmental DSS is proposed. Challenging the purported expertise of DSS, I draw on contemporary development, adaptive management and other literature to argue that, like knowledge, interpretations of expertise are also multiple and socially constructed. Alternative approaches to DSS development are explored which respond to the democratisation of expertise. Each of these approaches is presented as political processes in which validation of the structure, form and content of the DSS is enmeshed in systems of power. Consequently, I argue that regardless of the DSS development approach adopted, a commitment to equity and transparency dimensions of the IEM paradigm demands critical appraisal of the systems of power engaged during development, and their implications for bias. Addressing the purported efficiency of DSS, I further argue that the interrogation of potential biases during DSS development is imperative for effective - and efficient - delivery of decision support.

In response to recognition of the constructedness of knowledge and the partiality of science, this thesis proposes a reorientation of the processes of development and use of DSS to better recognise and manage the potential for bias. A new theoretical framework is proposed which reconstitutes DSS development as reflexive, precautionary practice. Drawing on the taxonomy of bias, an analytic framework is proposed to facilitate an interrogation of bias by developers and users of DSS to enable the anticipation, avoidance and minimisation, both prior to and during DSS design and development, of potential biases likely to interact transformatively with the decision-making environment.

To test the theoretically-derived frameworks in practice, the frameworks are used to guide reflexive DSS development in a joint Thai-Australian project which is developing a DSS to assist Integrated Land and Water Resource Assessment and Management (IWRAM) in the highlands of Northern Thailand. Firstly, the analytic framework is used in conjunction with a review of the highland environmental history and the political culture of highland decision-making to foreshadow potential biases if a DSS is introduced into the highland decision-making environment. Secondly, the theoretical and analytic frameworks are used to catalyse researchers collaborating in the IWRAM project to interrogate potential biases and negotiate convergent framings of decision support. In the light of the case study experience, the utility and effectiveness of the analytic and theoretical frameworks are assessed.

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Introduction

The Northern Highlands of Thailand - the case study environment of this thesis.

1. Introduction

1.1 Supporting integrated environmental management

In the 1950s, the dramatic social advancements enabled by new technological innovations led to a widespread public euphoria about the seemingly limitless capacity of humans to use science and technology to progress towards a modernised, utopian world. During the 1960s, several seminal critiques, notably Carson (1962), Mumford (1967), and Ehrlich (1968), highlighted the failings of the prevailing technocentric approach, including its role in instigating and exacerbating environmental crises. Over the ensuing two decades, public recognition increased of the threats that resource depletion and environmental degradation pose to human survival, and calls intensified for a radical change in approaches to dealing with environmental problems. A particular focus for critical attention was the fragmented nature of traditional state responses to environmental management, an administrative manifestation of the scientific reductionist belief that complex problems are best solved through disaggregation into their component parts. Critics argued that fragmented approaches were inadequate given the increasing complexity of modern environmental problems, and that they obscured the interrelationships among ecological, cultural, political and economic spheres in shaping environmental problems (Cairns and Crawford 1991, Bartlett 1990). In response to dissatisfaction with the management outcomes of disjointed, narrowly focussed environmental management, a shift was proposed towards a more holistic and integrated approach (Margerum and Born 1995, Born and Sonzogni 1995). Within this context, Integrated Environmental Management (IEM) gained support in both political and academic discourse as a better framework to guide environmental management (Lundquist et al.. 1985, Easter et al.. 1986, Lang 1986, Cairns 1991, Burke 1994, World Commission on Environment and Development 1987, United Nations 1992).

Under the rubric of IEM, environmental decision-makers now face an increasing torrent of information which they are expected to consider and analyse if they are to produce 'good' decisions. For example, Chapter 8 of Agenda 21 discusses the need to make systematic and simultaneous use of social, economic, developmental, ecological and environmental data, and to adopt comprehensive analytical procedures for prior and simultaneous assessment of the impacts of decisions (United Nations 1992:65,66). Accordingly, decisionmakers must monitor, process, assess, validate and analyse larger quantities of complex information, often within shorter time periods and more constrained financial resources. Perceiving some decision-makers to be drowning under the enormity of comprehending and managing the information deluge, developers of computer-based Decision Support Systems (DSS) have offered their systems as tools to navigate through the complexity of the incoming information. Advocates point to the potential efficiency, expertise and objectivity gains to be made through the use of DSS. On the surface, their arguments are compelling, and place DSS as an indispensable tool if we are to cope with the demands of modern environmental management. As a result, the past decade has witnessed escalating enthusiasm for, investment in, and development and application of environmental DSS.

However, from both academic and management spheres, an alternate perspective suggests that computer-based DSS may be more of a burden than a blessing. Some claim that, far from enhancing objectivity, DSS have been used to bolster particular political positions while invalidating alternate perspectives. Justifying their reluctance to incorporate DSS within their decision-making, other targeted users have argued that the DSS developed for them has failed to present as either expert or efficient. By attending to these latter concerns, this thesis will explore the (in)effectiveness of DSS to assist integrated environmental management.

1.2 Research focus and approach

This thesis will use the concept of bias (See Section 1.3.3) to argue that the effectiveness of conventional DSS to assist IEM has been undermined by the modernist and positivist underpinnings of DSS development and use. This research grew from a critical concern with exaggerated claims about and faith in environmental DSS, and a practical interest in a constructive reorientation of DSS to reconcile this concern. The thesis thus represents an attempt to link critical and reconstructive theory and practice.

Broad aims of this thesis are:

1) Drawing on post-positivist theory, to develop a critique of the conventional rationale for environmental DSS.

2) In response to this critique, to reconstruct the process of DSS development.

3) To trial the proposed reconstruction in practice.

As will be detailed in Section 2.2, this thesis has followed an evolutionary approach. As each of the general research aims above were addressed, themes and concepts emerged which refined subsequent aims. In particular, while addressing Aim 1, the notion of bias emerged as having explanatory power, and thus Aim 2 was amended to include development of theoretical and analytical frameworks which would guide an interrogation of bias. Aim 3 was consequently revised to include trialing these theoretical and analytical frameworks in practice.

As will also be detailed in Section 2.2, the focus of this research evolved through a dynamic interplay between theoretical concerns and practical experience as part of a joint Australian-Thai project which is developing a DSS to assist Integrated Water Resource Assessment and Management (IWRAM) in the highlands of Northern Thailand. To achieve Aim 3, the IWRAM project provided a case study to trial my reconstruction of DSS development. The case study research aims were:

3.1) To gain an understanding of the decision-making environment of the highlands of Northern Thailand.

3.2) To catalyse and facilitate IWRAM researchers to engage in an interrogation of bias guided by the proposed theoretical and analytical frameworks.

3.3) To gain insight into how different IWRAM researchers and other highland stakeholders construe decision support.

3.4) To explore the implications of differing construals for the anticipation of bias associated with the DSS.

3.5) To assess the effectiveness of the proposed theoretical and analytical frameworks.

Drawing on the experience of the IWRAM case study, two further general research aims emerged:

4) By drawing on the trial of the proposed frameworks in practice, to feedback to and refine the proposed frameworks.

5) By drawing on the trial of the proposed frameworks in practice, to evaluate the potential for the frameworks to be used in other contexts.

To fulfil the preceding research aims, I drew on both theoretical literature and substantive, grounded insights. As no single discipline emerged as having sole claim to the focus of this research, a transdisciplinary approach to both theoretical review and methodology was adopted. Literature discussing DSS is almost exclusively the domain of mathematicians, computer programmers, cognitive scientists and organisational decision theorists. My integrative approach to this inquiry, which drew on a variety of sociopolitical bodies of literature which are relevant to environmental decision support, but which have traditionally been neglected by DSS literature, enabled a new perspective on DSS development.

1.3 Key concepts

1.3.1 Integrated Environmental Management

Whilst environmental management literature notes diverse conceptualisations of the philosophy and process of IEM (for instance, Hufschmidt 1986, Born and Songozni 1995, Mitchell and Hollick 1993), general consensus has emerged as to several essential substantive dimensions. Underpinning IEM is an ecological sustainability ethic which connotes a commitment to favour management of the environment for long-term sustainability over exploitation of natural resources for short-term profit. Another cornerstone of IEM is an adherence to systems philosophy which emphasises interdependence between critical elements and processes of the ecosystem and focuses on those complex interrelationships, rather than solely on the behaviour of discrete individual components (Radosevich 1987). Consequently, a holistic, inclusive or comprehensive approach is promoted which directs the consideration of all relevant issues, variables and perspectives (Margerum and Born 1995). Due to emerging criticism of holism as inapplicable in practice, many recent IEM approaches replace the holism principle with a strategic or pragmatic focus on crucial issues, variables and goals, and their linkages (Mitchell 1990). Another fundamental component of IEM is integration among the multiple and often conflicting environmental perspectives of the stakeholders that comprise the community of interest within the management system (Margerum 1995). This yields an emphasis on participatory decision-making achieved through co-operation and collaboration instead of competition (Wallis and Robinson 1991:32). Reflecting its sustainability roots, principles of equity (including intergenerational equity, equity between human and natural systems and a respect for diversity of values) are also a critical dimension of IEM, and reinforce transparency in decision-making.

1.3.2 Decision support systems

The concept of Decision Support Systems (DSS) emerged during the early 1970s as computer-based systems designers began to explore how direct interaction with data and analysis models might help business managers cope more effectively with ill-structured problems (Sprague and Carlson 1982, Gorry and Scott-Morton 1971). An ill-structured problem implies that formulation of the problem (including the structure, constraints, scope and objectives) and of potential solutions are difficult to determine, uncertain and may change during investigation (Konsynski et al. 1992, Abel et al. 1996:1). The term 'Decision Support Systems' was coined to differentiate these endeavours from electronic data processing, management information systems (MIS) and operations research (OR) which deal with well-structured problems. Over the past two decades, the application of DSS has expanded beyond business spheres into broader arenas of decision-making, including medical diagnostics (Hudson et al. 1995), legal judgements (Nagel 1993), and military strategy (O'Neill 1998), as well as environmental management. Amongst numerous other natural resource decision-making problems, DSS have been developed to: support ecosystem and watershed management (Laacke 1995); perform environmental impact assessment for water resources development projects (Fedra 1995:10); manage environmental flows (Young et al. 1995); optimise crop production efficiency (Reddy and Pachepsky 1997:1143); manage forest stands (Nute et al. 1995); and forecast the spread of crop viruses (Morgan et al. 1997:1128).

While there is not a single, universal architecture for DSS (Wu 1996:9), several elements common to conventional systems may be distinguished. Sprague (1980:24) identifies three principal components of a decision support system: a database management or 'knowledge' system; a model base management or 'problem-solving' system; and a software system to manage the interface between the user and the system (Figure 1.1). Although a variety of alternate, more recent descriptions have been proposed (Kersten and Michalowski 1997:5), Sprague's classic description provides the essential conceptual elements.

To summarise the basic procedure, a decisionmaker interactively, via the user interface, accesses data stored in the database, generates alternatives using an appropriate model and arrives at a solution (Wu 1996:4). Data incorporated in a DSS might include electronic text documents, statistical data, tables of numerical data, rule-based representations of the knowledge of relevant experts, digitised maps or other electronically scanned images. The database manager processes and manipulates data to enable comparison, contrast, classification, and deduction. The model base may incorporate a variety of computer-based models which perform simulations or optimisations on data from the database for analysis, prediction or evaluation of decision alternatives. The model manager usually includes facilities for selecting models appropriate to a specified problem and for transforming the model output into a form suitable for display to the user. The interactive user interface system encompasses a variety of means which a user may engage to communicate with the system, such as a keyboard, touch screens, a mouse, or voice command, as well as ways of presenting information to the user, including the mode of graphic display and the problem description language (Mikolajuk 1996:8, Sprague 1980).

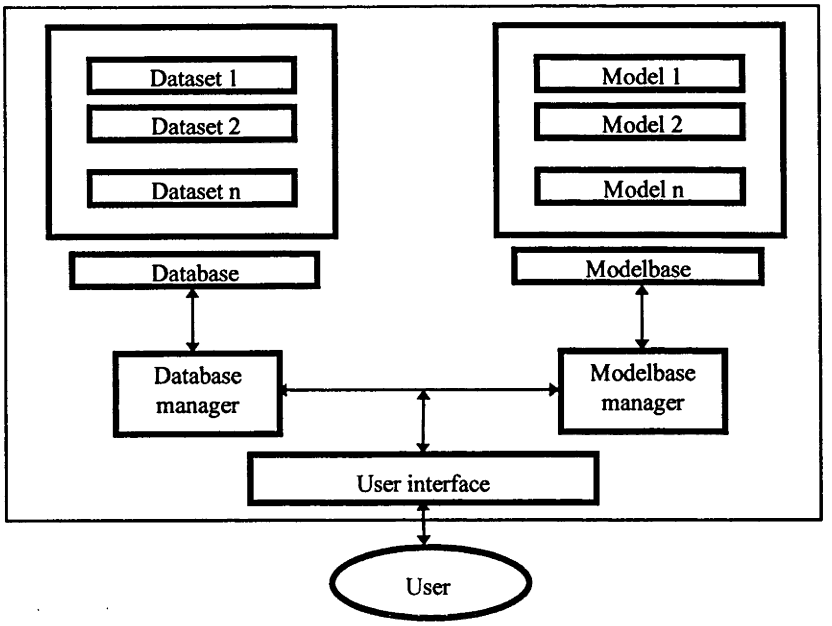


Figure 1-1 Generic DSS architecture (adapted from Sprague (1980:24))

Although DSS were intended as a move away from MIS and OR, conventional DSS design and development has been strongly influenced by these traditions. A legacy of the influence of these disciplines on the field of DSS has been the inheritance of an instrumental techno-rational approach to decision-making, which emphasises quantification, rationality and computational efficiency (Angehrn and Jelassi 1994:269). Accordingly, the dominant model of decision-making adopted throughout DSS literature is Simon's (1957:60) 'intelligence-design-choice' rational theory, which is used both "to explain the process of decision-making and to derive the characteristics of computer-based systems aimed at supporting this process" (Angehrn and Jelassi 1994:269). Adherence to Simon's model prescribes that effective decision-making entails: amassing optimal knowledge about the problem environment; selecting and ordering decision-relevant factors into a logical and transparent problem structure; generation, analysis and comparison of decision alternatives which satisfy specified decision criteria; and finally, selection of the optimal decision solution (Lein 1997:95, Kersten and Michalowski 1997:2). A further legacy of the historical context of the emergence of DSS has been inheritance of the traditional approach to computer systems development, whereby "a system is designed by computer specialists, in accordance with the technical and economic criteria set by management, but with little reference to current and future users; this design is then 'implemented' - with limited scope for modification" (Williams 1987:77). This approach is echoed within conventional environmental DSS design, where DSS tend to be "developed by groups of technical experts, quite separate from the 'hoped-for' end-users" (Ewing et al. 1997:3).

The features described above will be considered within this thesis as the conventional approach to DSS development. As will be highlighted in Chapter 3, a variety of new approaches are emerging within the DSS literature to challenge the conventional DSS paradigm. This thesis is located within this emerging critical literature.

1.3.3 Bias

In this thesis, which takes the ontological position that knowledge is socially constructed, bias is conceptualised as a relative, political term, indicating promotion of one perspective over another. A DSS is described as biased if the use of that technology is perceived to systematically promote (elements of) one stakeholder perspective over another, either because the content or output of the technology are perceived to promote (elements of) one stakeholder perspective over another, or because the use of the technology is perceived to limit the opportunities of certain stakeholders to participate in decision-making relative to before the introduction of the technology. Conceptualising bias in these terms recognises that bias, like knowledge, is socially constructed and negotiated, and that perceptions of bias will differ depending on the standpoint of the stakeholder who is attributing bias (cf Smithson 1989).

Within the positivist paradigm, 'bias' is defined as distortion from the true reality. Good research is deemed to be that which is non-biased. Thus, conventional usage of the term 'bias' often invites negative connotations. This thesis seeks to overturn an automatic interpretive alliance between 'bias' and 'substandard research'. As will be elaborated in Chapters 3 and 4, I argue that bias is inherent in DSS development, and that reflexive treatment of bias may enhance decision support.

1.4 Thesis structure

The structure of this thesis is illustrated in Figure 1.2.

Chapter 2 outlines the philosophical approach and methodology of the thesis.

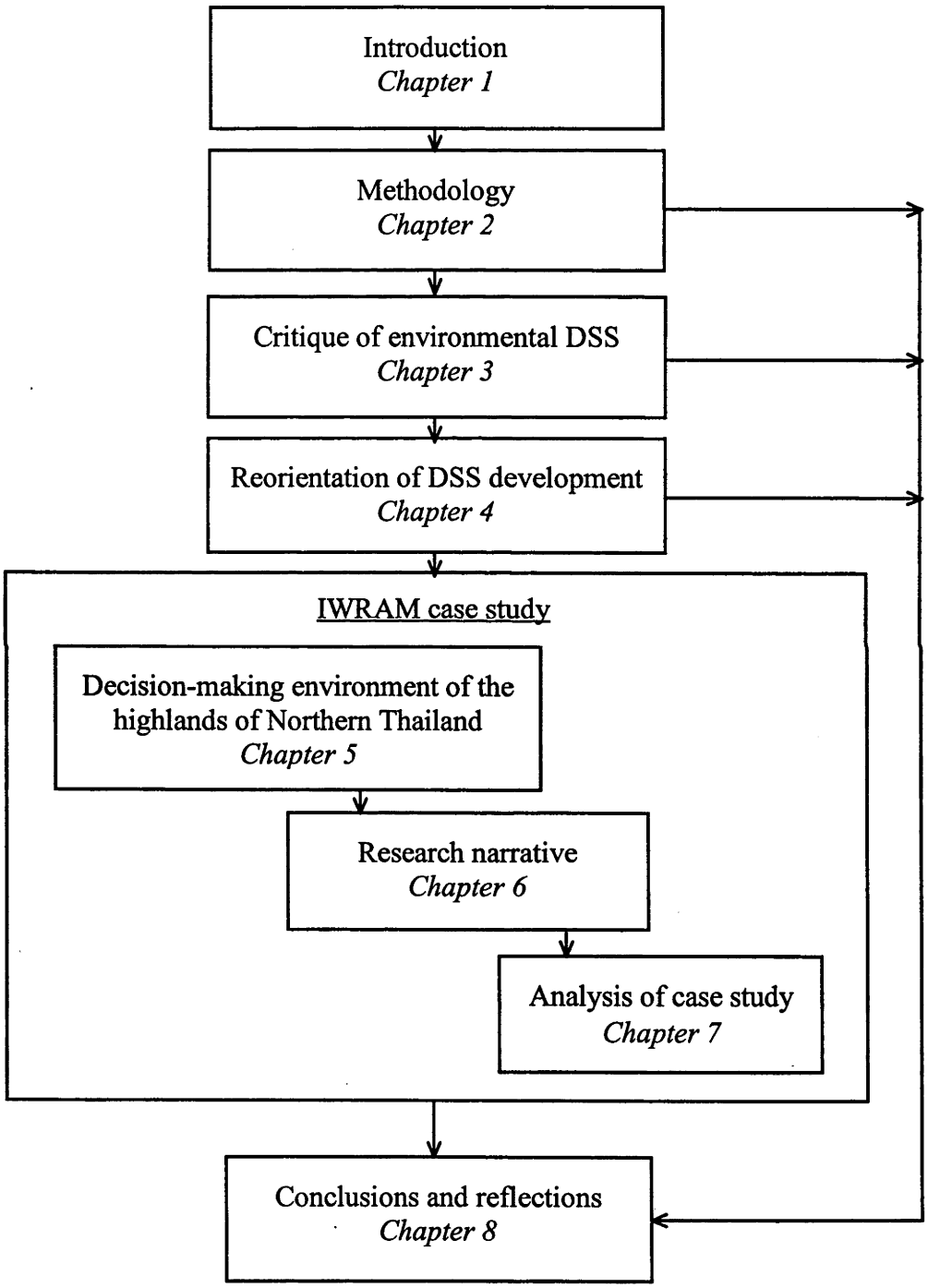
The initial part of Chapter 3 outlines the conventional rationale (objectivity, expertise and efficiency) for the development and use of DSS to assist integrated environmental management. The latter and substantive part of the chapter challenges the assumption that the conventional approach to the development of DSS yields innately objective, expert decisions. Instead, it is argued that bias is an inescapable feature of DSS. A taxonomy is proposed which identifies sources of bias relevant to the development and use of environmental DSS. Chapter 4 describes a new theoretical framework for the development of environmental DSS which emphasises precautionary practice and critical learning via the discursive interrogation of bias. Based on the taxonomy of bias, an analytical framework is proposed to guide interrogation of potential and existing biases associated with a particular DSS.

To test the potential of the frameworks proposed in Chapter 4 to inform DSS development, Chapters 5, 6 and 7 present a case study of the frameworks with the IWRAM project. Chapter 5 locates the case study analysis within the decision making environment of the Highlands of Northern Thailand. Note that to introduce and visually locate the highland environment, each of the chapter cover pages features images from the highlands of Northern Thailand. Chapter 6 presents a narrative of the evolution of the IWRAM project and the development of the IWRAM DSS, focussing on participants' engagement with the proposed frameworks. Chapter 7 analyses both the framing of decision support and the interrogation of biases in the IWRAM project.

The concluding chapter draws together the arguments and findings of the thesis. Implications of the thesis for the development of DSS and for the practice of integrated

research are advanced. Limitations of the research are canvassed, and future research directions are suggested.

Figure 1-2 Structure of this thesis



Methodology

Over the past century, the northern highlands of Thailand have been subject to extensive clearing, particularly for agriculture, including opium cultivation. This site, in a remote area of the highlands, cleared of all vegetation and on an open, sunny hill face, is probably intended for opium crops.

2. Methodology

2.1 Introduction

This chapter discusses the philosophy, approach and methods of this thesis. In much research, the process of inquiry is packaged as a neat hypothesis-testing study which has proceeded linearly according to its initial ideal research design. In this chapter, I have chosen an alternate style of presentation which reflects a commitment to transparency. I have aimed for an honest description of the research design as it evolved, including recognition of the unanticipated frustrations, opportunities, and insights which continually shaped the character and conduct of the research. This mode of presentation emphasises that the iterative (re)construction of knowledge manifested in this thesis occurred in a dynamic environment and was socially mediated by my relationship with my research participants (Steier 1991:4).

Section 2.2 discusses philosophical and epistemological assumptions that guided this inquiry and characterise key dimensions of my research approach. Section 2.3 recounts the narrative of the evolution of my research design. Sections 2.4 and 2.5 describe my data collection and analysis methods. Section 2.6 discusses the credibility, dependability, transferability and confirmability of these methods. Section 2.7 examines my role as a researcher, including my interactions with the participants in the IWRAM research team which emerged as the case study for this inquiry. Section 2.8 explores the sensitivity of this research topic. Finally, Sections 2.9 and 2.10 summarise the limitations and strengths of my methodology.

2.2 Philosophy and approach

The twentieth century, particularly since the 1950s, has been witness to multiple and mounting attacks on the dominance and validity of positivistic empirical inquiry. Critiques of the foundations and aims of positivism, and the practice of positivist research, have featured within numerous social research discourses, notably hermeneutics (Winch 1958), Marxism (Adorno 1967), feminism (Harding 1986), and communicative reconstruction (Habermas 1979, 1988). Among the new paradigm alternatives to positivist methodology which have been advanced are constructivism (Gergen 1985, Reason and Rowan 1981), naturalistic inquiry (Lincoln and Guba 1985, Erlandson et al. 1993) and deconstructionism (Derrida 1982).

Underlying and intertwined with both the research content and methodology of this thesis are ontological and epistemological themes common to many post-positivist approaches. Firstly, the positivist concept of a single external and tangible reality is replaced by the notion that there are multiple socially constructed realities. Methodologically, the acceptance of multiplicity and complexity encourages integration between and among different sociocultural perspectives, including conventional academic disciplines. Secondly, in contrast to the positivist norm of disengagement of the researcher from the researched, the researcher and the researched are viewed as interacting to influence each other. With disengagement rejected, inquiry emerges as an interpretive, personally and socially constructed process inevitably involving value

judgements. Consequently, the positivist emphasis on demonstrating absolute neutrality or objectivity is displaced in favour of a concern for self-interrogation and transparent communication of subjective influences. The research process may thus be regarded as a circular or spiralling process constituted and guided by social and self-reflexivity[1]. Accordingly, evolving, flexible research designs are emphasised. The reflexive, inter-subjective model of research leads to another common feature of post-positivist approaches: a tendency to view research as a collaborative exchange, rather than research on a passive subject.

Of the suite of post-positivist approaches, contemporary critical theory, in particular, captures several philosophical threads underlying the content and methodology of this thesis. Firstly, my interest in critiquing conventional approaches to DSS development, articulated in Chapter 3, has parallels with a prevalent theme within critical theory of deconstructing the conventional scientific enterprise. Secondly, this thesis shares critical theory concerns about "the ways social relations also mediate power relations to create various forms of alienation and inhibit the realisation of human possibilities" (Morrow 1994:10), as well as an emphasis on the importance of the social context of production and implementation of technology. Thirdly, informing my research design has been a commitment to aim for constructive, useable research rather than purely abstract theory, echoing the critical theory contention that "a theory has no real value unless it can be demonstrated to have practical implications" (Habermas 1979).

However, this thesis is not situated strictly within either critical theory or any other particular post-positivist approach. As no single theoretical or empirical field could have had sole claim to inform this inquiry, I searched widely for illuminating constructs from multiple bodies of literature. This integrative approach was not eclectic, however, as the concerns of the thesis privileged certain strands of literature. For example, situated learning theory and social and personal constructivism informed both my theoretical framework, presented in Chapter 4, and the methodology I selected for application of my analytical framework. To inform my analysis of the development of DSS by the IWRAM research team for the Northern highlands of Thailand, I reviewed literature treating the power dimensions of knowledge creation and negotiation in cross-cultural rural extension and development.

Reality construed as:	multiple, constructed realities
Knowledge construed as:	personally and socially constructed
Values:	transparency, pragmatism, critical thinking
Role of researcher:	catalyst, participant within research
Research approach:	integrated, reflexive, interpretive
Adapted from Carr 1994, Scoones and Thompson 1992, Morrow 1994	

Table 2-1 Dimensions of research philosophy and approach

[1] Reflexivity is discussed in greater depth in Chapter 4, Section 4.2.

Although the rest of this chapter focuses on my case study methodology, it should be emphasised that my research approach and philosophy, summarised in Table 2.1, applies both to my interactions with the case study and to the theoretical dimensions of this thesis, as the concept of the reflexive research spiral implies.

2.3 Forming and framing the inquiry

I began this research in mid-1995 as a core member of the IWRAM project which provides the case study for this thesis. At that stage, my intention was to conduct PhD research on integrated environmental assessment of the water resources of the Chao Phraya Basin, Thailand. My initial research focussed on literature reviews of the theory and practice of integrated environmental management, particularly watershed or catchment management, water resource conflicts associated with the Chao Phraya, and methods of integrating biophysical, sociocultural and economic analyses. Based on these literature reviews, I refined my topic to exploring the usefulness of different tools, particularly an operational framework and a computer-based modelling system, to guide integrated environmental assessment and management.

In October 1995, members of the Australian team proposing the IWRAM project ran a workshop in Laos on Integrated Water Resources Management for South-East Asia. At this workshop, I co-presented a paper outlining the intended methodology for the proposed IWRAM project. An invited Australian academic in the audience later wrote a paper critiquing the IWRAM approach (Hinton 1996). An anthropologist who had undertaken extensive research in Northern Thailand, he suggested that the IWRAM approach downplayed, perhaps even neglected, the political dimensions of resource use and management in Thailand:

> "...the model has difficulty in allowing for the fact that the small farmer has infinitely less capacity to realise his or her 'vision' than the cashed up, well connected logger, or narcotics dealer. There is also the unrecognised fact that the model is itself being produced by actors in the regional drama, for the people who develop IWRAM are not detached scientific observers: by professional background and career experience they have an interest in promoting technocratic nostrums and will naturally tend to associate with similarly minded institutions... within the region" (Hinton 1996:6).

Hinton's warnings resonated with several ethical issues regarding transfer of knowledge that I had been reflecting on during the previous months. After forays into dystopian, post-modern and community development critiques of technocracy, I had become concerned that conventional operational and modelling frameworks to assist integrated environmental assessment and management, based on Western conceptions of sustainability, may be unsuccessful in Northern Thailand, in terms of being supported by local actors, if those actors perceived the assumptions underlying the frameworks to be irrelevant in the local context. I proposed to interview key stakeholders in highland environmental management to elicit their different perceptions of sustainability and resource use, and to develop alternate operational and modelling frameworks which would better incorporate these perspectives.

From April through June 1996, I spent three months on field work in Chiang Mai, the Thai base for the IWRAM project. During this time, I also acted as a research assistant

for the IWRAM project[2]. This latter role primarily involved liaising between the Thai and Australian teams, and negotiating and strengthening relationships with potential project collaborators. This experience impressed upon me the extent to which meaningful research integration seemed to depend largely upon the effort placed on sustaining and improving the fragile network of communication among researchers. During my field work, I also became aware of widespread negative sentiments towards previous foreign development and research projects in the highlands of Northern Thailand. The failure of these projects to achieve their objectives was often attributed to the imposition of Western solutions and approaches which later proved inappropriate in the political, cultural, and economic environment of the Northern highlands. I became concerned whether an environmental decision support system developed in Australia for generic application to Asian river basins could ever pay adequate attention to the local context. I was particularly concerned that attempts by developers to incorporate 'the local perspective' in the DSS (as I had proposed earlier) would prove cursory, and would fail to confront possible deep-seated divergence between the developers' normative assumptions, embedded within the form and content of the DSS, and users' worldviews. With Hinton's (1996) warnings in mind, I was also concerned that those best situated to participate in development of (and ultimately use) the DSS would tend to be the more powerful and wealthy, which would have significant equity implications, and potentially create a tension with distributional and participatory dimensions of IEM theory.

My fieldwork experience led me to conclude that my topic should be reframed. Although I had gone to Thailand searching for the keys to achieving integration in an external decision-making environment, my field work experience had provided critical insights into the difficulties and complexity of attempting integration within my own and the IWRAM project's practice. Instead of seeking to construct an integrated DSS myself, I decided to concentrate on the process of development of a DSS for IEM. My interest lay in exploring whether it was possible to facilitate a more reflexive DSS development process which would provide a more effective tool for IEM by better recognising the potential for embedded biases and biases in access. Both Australian and Thai researchers involved in the IWRAM project expressed a willingness to participate in this research, and the IWRAM DSS development process became my case study.

A case study involves an in-depth, multifaceted investigation of a single social phenomenon in its natural, rather than an experimental, setting (Orum et al. 1991:2). Beyond providing a descriptive overview of the social context, a case study "entails an effort to discern and articulate the linkage between the phenomenon of interest and the actual social world in which it is embedded and sustained or reproduced" (Snow and Anderson 1991:154). Initially, I considered a comparative case study approach, contrasting the experiences of the IWRAM DSS development with alternate DSS development processes. However, because of difficulties in gaining sufficient access to other DSS development teams, I decided that an examination of those processes would be too superficial. Consequently, I decided to focus on the IWRAM project as a single, intensive case study. This decision accorded with the intensive research design approach encouraged by both critical theory and action research. Intensive research

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[2] This role is described in further detail in Section 2.7.

designs emphasise "explicating the operations of causal processes and meaning structures in a single or limited number of cases" (Morrow 1994:250).

My supervisors at that time, both members of the IWRAM research team, advised me to explore action research as a potential method. Action research is a methodology popularised by Lewin (1946) which emphasises improvement of personal practice through self-reflective inquiry (McNiff 1988:1-3). Within action research, the subject of research is not external phenomena but professional practices (Robottom 1987:111). I drew on action research principles in my framing of my thesis topic in that a key motivation was to improve the practice of integration and DSS development within the IWRAM project which I had been participating in through interventionist experiential learning (Argyris and Schon 1991:86).

Participatory action research is "a form of action research that involves practitioners as both subjects and coresearchers" (Argyris and Schon 1991:86). I incorporated participatory action research principles in this research in the sense that I did not seek to reform the IWRAM DSS development process by imposing my perspective of progress. Instead, I framed my role as catalytic. Thus, I focussed on facilitating and highlighting participants' construing of biases associated with the DSS and also potential actions that might be taken to manage those biases. However, this thesis does not follow a strict participatory action research model. Firstly, from the point at which I reframed my thesis, I ceased to be directly involved in the DSS development. Furthermore, the need to preserve the academic independence I believed necessary to acquire a PhD for this research meant that I maintained control over the topic and direction of this research. Thus, the research was not a collaborative project driven by the negotiated agendas and concerns of the community of practice involved, as a participatory action research study would demand.

The evolution of the research design is illustrated in Figure 2.1.

2.4 Data collection

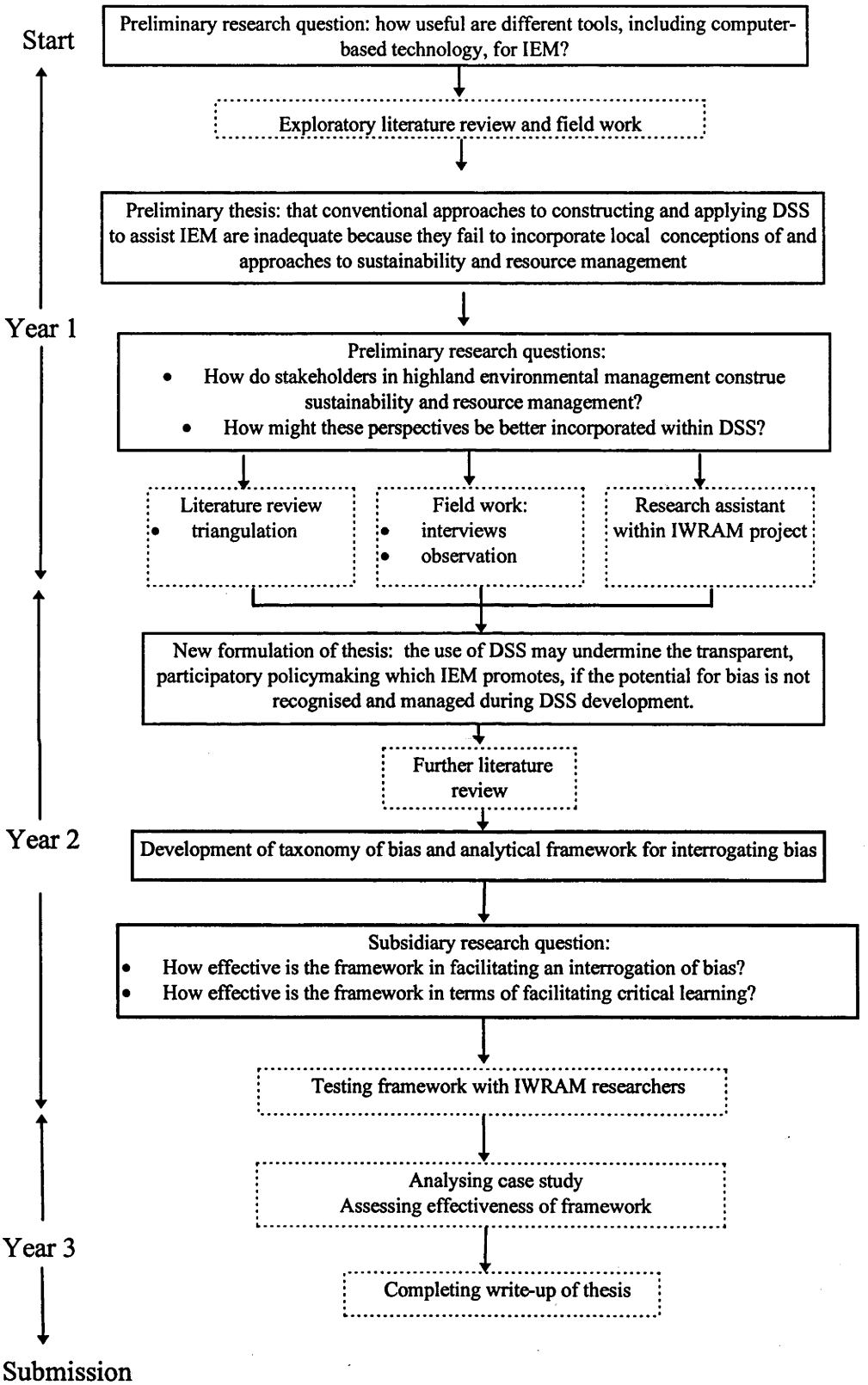
I employed multiple qualitative methods to elicit data to inform my research aims, illustrated in Table 2.2.

2.4.1 The decision-making environment of the Northern highlands

My first case study aim was to familiarise myself with the decision-making environment of the Northern highlands. To achieve this aim, I used document analysis and interview techniques. Document analysis entailed critical review and analysis of literature (mostly in English, also translations of relevant Thai literature) and other written material, including e-mail summaries of Thai newspapers, and relevant internet sites. In reviewing literature, I concentrated on constructing a chronological narrative of the evolving highland decision-making environment, from pre-modern settlement through to the present. This methodological approach was selected to highlight recurring themes, particularly persistent conflict between stakeholders' alternate framings of the highland environment, environmental problems and environmental decision-making.

Further insights into the decision-making environment were gained through interviews with different highland stakeholders including: casual conversations; unstructured, semi-focussed individual interviews; and semi-structured, focussed individual interviews. A snowballing technique was used to identify prospective interviewees,

Figure 2-1 Evolution of the research design



Research aims	*Data collection methods*
To gain an understanding of the context of application of the DSS, namely the decision-making environment of the highlands of Northern Thailand	• document analysis • interviews: casual conversations; unstructured, semi-focussed interviews; semi-structured, focussed interviews
To gain insight into how different IWRAM researchers and other highland stakeholders frame dimensions of decision support	• participant-observation
To explore the implications of these differing modes of framing for the anticipation of bias associated with the DSS	• participant-observation • framework for anticipating bias: questionnaires, group dialogues, semi-structured and structured interviews
To assess the usefulness and relevance of my framework for anticipating and reflecting on bias	• participant-observation • analysis of framework application

Table 2-2 Data collection methods

whereby an interviewee would suggest other people who would be useful to interview, and so on. Those people who emerged as key informants were generally reinterviewed, often over the course of several social engagements, such as lunches, dinners, and informal parties. Interviews were mostly conducted with English-speaking stakeholders. However, the perspectives of key non-English speaking participants in Thai environmental management were also sought. On each occasion, a translator was engaged with whom both I and the interviewee had already established rapport and trust. A tape recorder was not used during interviews because consultation with a range of interviewees suggested that the tape recorder would be invasive and would inhibit frank and open conversation. Instead, I recorded interviewees' responses in a field notebook.

Insights gained into the decision-making environment are presented in Chapter 5 as a narrative of the highland environmental history and the political culture of highland decision-making. They also inform an interrogation of potential biases associated with introduction of DSS into the highland decision-making environment, Section 5.6.

2.4.2 Modes of framing decision support

Personal construct theory emphasises that "one need not actually adopt or share the constructs of another person (or culture) in order to understand them, but must be capable of construing what they are construing" (Ross 1996:181, Kelly 1955). To explore the different ways that IWRAM researchers were framing decision support, I needed to construe the IWRAM researchers construing of decision support. To this end, I engaged in participant observation. Observation has long been regarded by qualitative researchers as a fundamental method for understanding another cultural setting (Silverman 1993:9). Participant-observation presupposes that a researcher who becomes directly involved in the study context may gain insights into phenomena which would be obscured from the standpoint of a non-participant (Jorgensen 1989). As noted by Ross (1996:184), participant-observation provides a practical and less-intrusive method to gain insight into another's construing.

My participant-observation mainly took place at the Centre for Resource and Environmental Studies, where most of the Australian IWRAM researchers and myself were based. For approximately three years, I participated in and observed project meetings, workshops and everyday interactions between project personnel and other stakeholders. I took annotated minutes during formal and informal meetings and workshop discussions. Many critical insights emerged during the times I was employed by the project as a research assistant. This role is described in Section 2.7.

I also engaged in participant-observation with Thai IWRAM researchers and other stakeholders in highland environmental decision-making. I spent approximately six months, spread over five trips, on fieldwork in Thailand, mainly based in Chiang Mai at the Office of Highland Development (OHD)[3]. I observed work patterns and priorities, and talked informally with Thai project personnel and other stakeholders about the highlands. I observed and often participated in meetings involving Thai IWRAM researchers. On occasion, where language difficulties arose, a tape recorder was used to check written notes on meetings. I accompanied OHD workers on field trips into the highlands and observed the way they related to the landscape and other stakeholders. These field trips provided opportunities to gain insight into the complexities and paradoxes of the highland decision-making environment. These insights contributed to the circumtextual frame (MacLachlan et al. 1994:4) which shaped and informed my constructions and interpretations of the Thai IWRAM researchers' personal and social interests and commitments. Box 2.1 reproduces excerpts from one field trip.

Other opportunities to gain an alternate perspective on the highland environment came in the form of social interactions, including being invited on a number of family holidays in the highlands with Thai collaborators in the IWRAM project. For example, I was invited by a Department of Land Development (DLD) official to drive with him and his daughter to a wedding in Chiang Rai and then to tour the Golden Triangle region. During the journey, we visited his lychee farm, had a meal with his friend who runs one of the DLD regional field stations, and, at the apex of the golden triangle, discussed the stark differences between the Lao, Burmese and Thai approaches to highland development and management. As with the field trips, these social interactions provided valuable insights which would otherwise have been inaccessible.

Through personal field notebooks, I kept an ongoing record of my participant-observation experiences. I detailed observations of and reflections on activities pertaining to the case study. I also noted conceptual or practical difficulties I experienced, as well as substantive redefinitions or refinements of my research. As a visual reminders of events, informants and the environment, I incorporated photographs and slides in my notebooks.

Participant observation ranges across a continuum from full participant through participant-as-observer and observer-as-participant to full observer (Glesne and Peshkin 1992:40). During my early involvement with the ANU-RPF project, my role was as a full participant in that I was an integral functioning member of the project team. From the point at which I decided to focus on the ANU-RPF project as a case study, my role oscillated between a participant-as-observer (primarily reflection on intensive

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[3] Figures 5.1 and 6.1 show how the OHD is situated amongst highland stakeholders and OHD personnel are situated within the IWRAM research team.

interaction with the project) and an observer-as-participant (primarily observation of the project and limited interaction with the project).

To complement my observations, I created a chronological archive of email and other correspondence with different IWRAM researchers which I had collected since my first interactions in 1995 with the IWRAM project. Throughout the course of my research, many of the IWRAM researchers routinely copied their email correspondence about the DSS to me, and provided me with their personal notes and sketches of the DSS. These were added to the archive and have provided an invaluable source of information detailing the different researchers' perspectives on the DSS over time.

5 November 1997 - Hmong village in Pha Yao province

We have driven for four hours to get to this Royal Project station. [X] is here to brief the new Governor of Pha Yao about his land use plans for the three villages in this area. [X] got in trouble with the last Governor because he agreed that the villagers could grow a small plot of opium for the elderly addicts so they didn't turn to heroin. [X] told the Governor about it and the Governor agreed - then turned the situation into a campaign stunt by storming up to the village with army in tow, pretending to 'discover' the 'illegal' stash.

The new Governor arrived with an entourage of about 25 officials, 5 policemen and 5 soldiers with AK47s. The Hmong villagers watch us unsmiling from behind tall grasses. This place is surrounded by land mines which the dirt road traverses carefully between. I interviewed the Governor briefly. He wants to help the highland people to raise their income by growing organic fruit and flowers, so they won't grow opium. He said he would help market their crops in Pha Yao. He also said he supported the use of computer technology because it leads to more effective decisions. This place makes it clear how much land use depends on the ability to market crops - the incorporation into the market economy.

The headman moved here about 20 years ago from higher on the mountains where he grew opium and hunted hawks, deer and other birds. Now he has about 20 rai and grows rice, corn and flowers. He showed me his land. His flowers this year weren't successful because he picked them too late - the blooms had opened already. His favourite crop is flowers because of the money they collect. He prefers this place to his old village on the mountains because it has a road and it is easier for him to take his crops to the town to sell. He has a pickup now which he bought from his profits. He hesitated when I asked him what he liked to spend his money on - said finally that his wife likes to buy new clothes. Only one of his four sons live in the village - one works in Singapore and two are studying in Chiang Mai, supported by monks. When I asked if there was anything about the village he would like to change, he couldn't think of anything - he said he leaves that up to the Royal Project people.*

** 6.25 rai = 1 hectare*

Box 2-1 Excerpts from field notes

2.4.3 Framing decision support: Implications for bias

My proposed analytical framework for anticipating bias (see Chapter 4) was the primary methodological tool that I employed to explore the implications of different modes of framing decision support for the reflection on and anticipation of bias. As some methodological points were relevant to either the case study narrative or assessment of the utility of the framework, the framework application methodology is partly contained within the case study chapters, Chapter 6 and 7. This section presents methodological notes about the techniques employed: questionnaires, group dialogues, semi-structured and structured interviews.

I decided to divide my testing of the framework into sessions pertaining to each of the three sections of the framework: (A) Background; (B) Embedded bias; and (C) Biased access. My initial plan was that each participant would complete a questionnaire on these themes, then the participants would meet and engage in a group dialogue about their responses to the questionnaire. I selected structured but open-ended questions in order to elicit participants' responses in their own words, see Appendix 1. According to their preference, the participants filled out the questionnaires either in writing or in an interview. Generally, the participants chose to fill out their questionnaires in my presence and to provide me with a running commentary of their responses. The questionnaires provided a comparative source of data to establish participants' individual positions prior to the group dialogue, as well as a point of triangulation for interview and observation notes. I selected group dialogues to provide insight into whether and how interaction between participants might promote learning in terms of exposing convergences or divergences in perspective.

The three Australian leaders of the biophysical, sociocultural, and DSS components of the IWRAM project agreed to participate in a trial of my framework for anticipating and interrogating bias. Other researchers in the Australian team had yet to be appointed. In May 1997, the Australian biophysical, sociocultural and DSS leaders engaged in a facilitated set of interviews concerning Part A of the framework. To keep the costs of participation in terms of time expended to a minimum, the group dialogue was limited to an hour.

The methods used for Part A had two key limitations. Firstly, participants tended to restrict their interaction to reading their prepared questionnaire responses rather than engaging in discussion. Secondly, the demands of facilitation hindered my note-taking. Consequently, for Part B, which was tested in July 1997, methods were altered. In order to stimulate greater debate, I prepared a set of discussion prompts based on issues which had emerged from the participants' responses to the Part B questionnaire. Each participant was provided with a handout which comprised the collated responses so that they could view the diversity of responses. A tape recorder was used to complement my notes.

As Chapter 7 discusses, Part C of the framework was not trialed with the Australian team because they felt it was too premature to reflect on issues of biased access.

I had initially intended to test the analytical framework with the Thai researchers involved in the IWRAM project in parallel with the Australian application. Because of a lack of finances to fund field trips to Thailand, I attempted to interact with Thai researchers via e-mail. However, it soon emerged that e-mail was not an effective means of communicating, partly due to pragmatic reasons. For example, a single e-mail account was often shared by an entire department, leading to frequent instances of messages being lost, and computer-time tended to be rationed to around ten hours per month for a whole department, so communications were infrequent and brief. Consequently, I arranged with the Thai researchers that I travel to Thailand to test the framework in person. The Thai-based case study eventually took place in November 1997, following the Australian application. The mode of using the framework with the Thai team necessarily differed from the Australian experience. Firstly, as a larger number of researchers (eight) were to participate, and as I had more limited time to test the framework, I condensed the three framework sections into a single interview guide

(Appendix 2). As English was not the Thai participants' first language, I simplified some of the questions, and reworded others in more everyday rather than academic English. Consultation with each of the Thai participants as to their preferred mode of interview and level of participation also led to alterations in the methodology from the Australian experience. For example, although most participants felt comfortable with a semi-formal interview, others preferred to respond to my questions over the course of several informal, and often more social, interactions.

I had originally intended that following the individual interviews with the Thai participants, I would co-facilitate a workshop in which issues emerging from the interviews could be discussed, in a similar fashion to the Australian group dialogues. However, several Thai participants advised that a formal workshop was likely to be consumed by protocol pleasantries, and that an informal meeting was more likely to result in frank discussion. In addition, the interviewees suggested that it would be better in terms of group politics if I arranged and facilitated the meeting alone, rather than seeking to co-facilitate. Consequently, I convened an informal meeting and sent each interviewee an agenda, Appendix 3, which comprised issues which I had distilled from the interviews as significant. The meeting was mostly conducted in Thai, and various participants translated the discussion where my Thai proved inadequate for me to comprehend the responses. As further checks on my comprehension of the meeting's discussion, I asked the DSS leader to prepare a report of the meeting, and spent an afternoon with the GIS researcher discussing the dialogue and outcomes of the meeting.

During January and February of 1998, I also facilitated a trial of the analytical framework, following the single interview guide method developed during the Thai case study, with four new members of the Australian team.

2.4.4 Assessing the framework for anticipating bias

The methods of participant-observation, individual interviews and group dialogues described above were also used to yield data which would allow assessment of the framework for anticipating bias. In addition, for the Australian trial of the framework, I provided participants with evaluation questionnaires following each group dialogue. This enabled insight into participants' own appraisal of the practicality and effectiveness of the analytical framework in terms of catalysing learning and revealing convergences or divergences in perspective.

2.5 Data analysis: Relating data and theory

The process of analysing data and comparing emergent patterns and themes with my theoretical concerns was ongoing and iterative throughout this research. Thus, although I am presenting data analysis as distinct from data collection, it should be emphasised that these processes were intertwined.

As a central part of the analytical process, I embarked on metatheoretical reflection within a series of journals on the relations between myself as researcher, the participants in my research, the data generated, and theory. In particular, I wrote about possible insights that my observations, interviews, documents and literature might offer for integrated environmental research or DSS development. I also continually queried whether patterns and themes emerging from data contradicted or lent coherence to theory, and vice versa.

2.5.1 Dealing with transcripts

To analyse interview and group dialogue transcripts, I adopted a thematic analytical approach (Sadique 1996:28). Each of the interviews and group dialogues was transcribed into Microsoft Word. To begin coding interview and dialogue transcripts, I first selected and read one of the transcripts, noting broad themes that emerged from the data. I then printed out as many copies of the transcript as themes identified. For each theme, I examined the transcript, highlighting instances when that theme arose, and noting how each highlighted quote related to the theme. As I worked with the transcript, further themes emerged which were treated in the same manner. I repeated this process for the other transcripts, then compared the themes which had emerged in the light of my research focus. I realised that the themes accorded with three hierarchically linked categories: biases; the DSS and DSS development; and the decision-making environment.

I next constructed a table within Microsoft Word. Each transcript was copied in its entirety into the table. Cell breaks were inserted according to changes in theme. Each quote was thus coded according to theme, and then tagged with the identification label of the participant, the date of the interview or questionnaire, the theme, and the question number. Where a cell corresponded to more than one theme, the cell was copied and double-coded. Where existing themes proved inappropriate, the cell was coded as 'Other'. Recurring themes within the 'Other' category were promoted to their own category and sorted into the overarching hierarchical categories. Thus, coding categories emerged from the data, shaped by my theoretical concerns. The final coding frame is reproduced in Appendix 4. Sorting the data table by identification label, then date, then theme allowed examination of the evolution one participant's perspective over time. Sorting the table according to date, then theme allowed comparison of different participants perspectives on a particular issue at a particular time.

2.5.2 Analysing quotes

Once the cells had been woven thematically into a chronological narrative, presented in Chapter 7, each quote was reanalysed in terms of the mode(s) of framing it portrayed, Box 2.2. During this iterative process, I noted patterns emerging from the data which suggested interests and personal or social commitments which shaped the modes of framing, including assumptions about the decision-making environment, particularly relationships between stakeholders, and assumptions about the best way to approach problem-solving including issues of scale. Each quote was then reanalysed in terms of these themes.

How is the DSS framed?	How is DSS development framed?
• purpose • form • content • biases	• purpose • form • biases

Box 2-2 Analysis of modes of framing

2.5.3 Analysing documents and observations

Throughout the research process, I intermittently reviewed my archive of documents and notebooks of observations to compare them to theory and insights from literature. I reviewed the archive more intensively once different participants' modes of framing or approaching biases, DSS development and the decision-making environment began to emerge. Text, diagrams and observations pertaining to different participants' modes of framing were highlighted. The chronological nature of the archive allowed me to compare these with the dated, coded quotes. This provided me with a richer picture of participants' construing of biases, DSS development and the decision-making environment, and a means of gauging how issues raised during interviews or group dialogues may have affected the IWRAM project's practice.

2.6 Credibility, dependability, transferability and confirmability

Within the positivist paradigm of research, reliability and validity must be established to legitimise inquiry. Thus, Kidder (1981:7) argues that: "Research is valid when the conclusions are true. It is reliable when the findings are repeatable. Reliability and validity are requirements for both the design and the measurement of research. At the level of design, we examine the conclusions and ask whether they are true and repeatable. At the level of measurement, we examine the scores of observations and ask whether they are accurate and repeatable". However, as articulated most convincingly by Lincoln and Guba (1985), this stance is problematic if a constructivist position is adopted. Firstly, internal validity conventionally refers to the extent to which the data of an inquiry represents the reality it is claimed to represent. This positivist definition presupposes the existence of a single objective reality which the researcher can determine. Lincoln and Guba (1985:296) suggest that if multiple constructed realities are assumed, then the credibility of the findings of an inquiry should rest instead on the extent to which the researcher's reconstructions of realities are perceived as credible interpretations of the original multiple realities.

Several strategies suggested by Lincoln and Guba (1985) to establish credibility were employed in this thesis. Firstly, prolonged engagement with the IWRAM project and persistent participant-observation of daily events within the project enhanced my ability to understand and interpret these events in context. Secondly, triangulation of information about events and relationships illuminated similarities and differences in constructions. This was achieved through: conducting multiple interviews, including interviews with highland stakeholders not participating in the project; and comparing individuals' verbal statements with observations and project documentation (draft proposals, meeting minutes, emails, conference papers). I also reviewed my perceptions and analyses with other researchers both within and outside the project to explore alternate constructions. In the case of IWRAM researchers, I discussed my findings informally, and asked participants to verify my written case study narrative and analysis. In Chapter 6, where researchers argued for an alternate reconstruction of events or themes, these are footnoted.

Reliability conventionally implies that "the findings of an inquiry would be repeated if the inquiry were replicated with the same respondents in the same setting" (Lincoln and Guba). However, replicability rests on the notion of an unchanging tangible reality. If 'reality' is perceived as ephemeral and changing, then "observed instability may be

attributed not only to error but also to reality shifts" (Erlandson 1993:34). Promoting the dependability of the research thus necessitates detailed communication of the research process and setting in such a way that future researchers may assess likely sources of variance between research settings (Lincoln and Guba 1985:299). To this end, I have made a conscious effort to describe both my methodology and the IWRAM project in sufficient detail in this thesis to facilitate future comparison. I have also maintained an archive of documentation, questionnaires, interview notes, participant-observations, and several reflective journals relating to my research.

External validity pertains to the generalizability of research findings. The constructivist paradigm does not seek to develop generalizable results, as it is assumed that "all observations are defined by the specific contexts in which they occur" (Erlandson et al. 1993:32). However, this does not imply that knowledge gained in one context is regarded as irrelevant to other contexts. Instead, the constructivist paradigm maintains that transferability of theoretical concepts between contexts is possible if the contexts possess similar characteristics (Marshall and Rossman 1989:146). Hence, the significance of this study is not limited to the IWRAM project, but instead yields insights relevant to the theory and practice of both DSS development and integrated research. In Chapter 8, I draw links between my findings and broader theoretical concerns, and suggest lessons for DSS development and integrated research.

If one accepts that objectivity is an illusion because the researcher can never be completely disengaged from the methodology they select and construct, then the credibility and trustworthiness of research findings also rests on the extent to which a reader may interrogate the biases of the researcher. As Bruner (1990:25) notes, "Constructivism's basic claim is simply that knowledge is 'right' or 'wrong' in light of the perspective we have chosen to assume... The best we can hope for is that we be aware of our own perspective and those of others when we make our claims of 'rightness' and 'wrongness'". To communicate the partial and positioned character of research, I have drawn on techniques of self-reflexivity, and emphasised transparency of method, data and analysis in presentation of this thesis. In Sections 2.3 and 2.7 of this chapter, I explore how my role as a researcher has influenced the conduct and outcomes of this inquiry. In particular, I attempt to illuminate how my interactions with and reflections on the IWRAM project, as well as my constructions of meaning, interpretations, emotions and actions may have influenced both my own and the IWRAM project's research process. Meanwhile, in the case study chapters, I have used interviewees' quotes liberally so that readers may assess my interpretations and analysis of their verbal constructions for bias.

2.7 Confronting reflexivity: Role of the researcher

From the outset, my background shaped the way in which I chose to frame the topic of this research. For example, previous disenchantment as a physicist with the limitations of models in adequately capturing the phenomena under investigation has prompted greater interest in what technology cannot do rather than what it can. This has led to a focus in this thesis on the risks of technology rather than on the opportunities. As a New Zealander, I have observed the resentment shown by many Maori people towards perceived instances of the imposition of Pakeha (European) institutions, logic, laws and expertise. This heightened my awareness of manifestations of neo-colonialism, and contributed to my concerns about the imposition of Western technology on the Thai

highland decision-making environment. My interest in the implications of divergent perspectives was further attenuated by personal experience of alienation and cultural difference following my move from New Zealand to Australia, and later to Thailand.

It is important to detail my interactions with the IWRAM project to acknowledge intersubjectivity within my research. My relationship with IWRAM participants was multidimensional. My early interactions were solely as a PhD student formally associated with the project, intending to undertake an integrated environmental assessment of the water resources of the Chao Phraya Basin, Thailand. In this context, I circulated literature reviews relevant to my thesis topic amongst prospective IWRAM researchers, and selected a procedural framework to guide the IWRAM project's research, which was subsequently adopted by the project proponents as their conceptual framework for research. At various stages during my thesis research, I also acted as a part-time research assistant with the project. In this capacity, I assisted with coordinating individual submissions for the IWRAM funding proposal into a coherent draft, synthesised a summary of the IWRAM project from the funding proposal, and prepared drafts of several conference papers detailing the approach and methodology of different components of the project. I also assisted in running workshops, establishing links with collaborators, and liaising between the Thai and Australian IWRAM researchers.

2.7.1 Access and rapport

Rapport describes the character of effective field relationships and is marked by confidence and trust (Glesne and Peshkin 1992:93,94). Many texts intimate that gaining access and establishing rapport are stages through which the researcher must pass before 'uncontaminated' data may be derived (May 1997:142). However, in my experience, negotiating access and building rapport were both ongoing processes throughout the research.

As access and rapport did not present as significant an issue in the Australian case, I will mainly focus in this section on the Thai context. However, a few points regarding access and rapport with the Australian participants are worthwhile noting. Firstly, my initial role as a core member of the Australian IWRAM team, and my subsequent, intermittent, role as a research assistant for the IWRAM project, were key factors in developing and maintaining trust and rapport with the Australian IWRAM researchers. However, over time, my research assistant activities also caused me to feel significant tensions in terms of both time-management and intellectual space, leading me to decide to restrict access during 1997. In order to demarcate the end of my thesis-related interaction with the IWRAM project, and allow me to concentrate on my write-up, I elected to further restrict my access to the project after November 1997.

There is a widely held perception amongst Thai people that Western academics and consultants often disregard and undervalue the capacity of Thai people to plan for their own future and to develop effective strategies for coping with problems. Until their credibility has been established, Western researchers may thus be treated with ambivalence, or even distrusted as intellectual colonialists who seek to impose Western 'solutions' on an 'undeveloped' country. These attitudes presented a challenge in terms of engendering trust and credibility for my research, and also significantly influenced the direction of my study. As I interacted with key Thai informants, I continually emphasised that my thesis research was not intended to follow the colonial tradition, but

rather was intended to offer insights to Thai and Westerners alike into difficulties presented by the application of Western-designed technology in a Thai context. Achieving consistency between these assertions and the character of my research required considerable and continuous reflection on and modification of my research approach and design.

My identity as a young Eurasian woman helped to distance me from the older Anglosaxon (often American) men who have generally undertaken research and consultancies in Thailand according to the colonial model. Having lived and worked in several Asian countries, my familiarity with the customs, history and etiquette of those cultures, combined with demonstrated interest in learning nuances of Thai traditional dance, music, cuisine, and language, enhanced my assurances that I wished to gain insight rather than to impose a Western worldview. None-the-less, infrequent, casual remarks from one key Thai informant throughout the course of my thesis warning me that "What works in Australia may be unsuitable to the Thai" served as a reminder that suspicions run deep.

The time required to develop and maintain sufficient rapport with Thai participants to elicit confidential, personal responses rather than the "official line" should be emphasised here. Again, my identity as a young female often assisted in this, with several participants identifying me as the same age as their daughters. I was subsequently encouraged to make friends with their daughters and invited to a number of family social occasions. Playing the guitar also assisted in breaking down barriers during informal social occasions. Once social rapport had developed, this carried over into work settings, and informants would volunteer confidential, explanatory commentary of events, including the politics behind the scene.

The role of patronage, or at least introductions from a trusted source, in establishing rapport should also be emphasised. In many instances, particularly with government officials, rapport increased dramatically when my association with the Royal Project Foundation was established[4]. However, in the case of villagers and some NGOS, rapport improved when I cited my collaboration with the Thai sociocultural team, who were well known as supporters of a collective of highland villagers campaigning for environmental and social justice.

After July 1997, the unanticipated severity of the Thai financial crisis exacerbated difficulties in arranging and conducting interviews as potential interviewees were no longer secure about their future (including their employment). Thus, many found it difficult to focus on theoretical concerns about a hypothetical computer system. Initial interviews were often dominated by the interviewee relating the difficulties they were confronting personally as a result of the economic situation. Considerable patience and extra time (repeat visits) were required to encourage interviewees to attend to the topic of the interview.

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[4] The Royal Project Foundation (RPF) is described in Section 5.5. The Thai collaborators in the IWRAM project were coordinated under the umbrella of the RPF. Due to its association with the King of Thailand, it accords respect amongst many Thai people.

2.8 Sensitive research

Lee and Renzetti (1993:5) describe a sensitive research topic as one which poses a substantial threat for either the researcher or the researched, therein raising methodological, ethical or political problems. Two aspects of this research presented difficulties because of sensitivity. Firstly, reframing my research as a case study of the IWRAM project was problematic in that two of the Australian IWRAM researchers who would be subjects of my research were also members of my supervisory panel. Given their roles as project leaders, I felt that it was imperative that I include them in my research process. However, I also needed to be assured of the independence of my analysis. To cope with this situation, an alternate supervision panel, including a new primary supervisor, was instituted to assist in my preparation of the interviews, to oversee my research during this period and to critically examine my subsequent analysis.

Secondly, I recognised that the success of the IWRAM project would be likely to influence the subsequent funding of similar projects proposed by the IWRAM team. In the light of this, I was mindful that a critique of the project could be construed as threatening. The IWRAM researchers did not raise this as a problem; instead, many professed support for a critical approach. None-the-less, reflecting on the post-positivist norm of collaborative research, I felt that ethically I did not wish to jeopardise the future of the participants in my research. This contributed to my decision to incorporate action research principles, including recognising the improvement of the practice of the IWRAM project as a central intent of my research. During the write-up of this thesis, I have consulted participants about whether they accord with my analysis and conclusions, and invited them to note divergences. I have also emphasised my willingness to negotiate restricted dissemination of this thesis if the content or conclusions are construed as threatening.

2.9 Limitations of the methodology

Although methodological and theoretical pluralism may enhance research, it also introduces limitations in terms of the depth that may be achieved. Integrating perspectives for transdisciplinary research inevitably requires the researcher to invest trust in other researchers' analyses or syntheses of theory and methods. More extensive review of critical theory, organisational learning, rural development and personal construction literature may have contributed additional insights. However, the time constraints of a PhD thesis determined otherwise.

Despite the measures taken to enhance credibility and confirmability, limitations remain in terms of accurate representation of IWRAM collaborators' and other highland stakeholders' constructions of environmental decision-making and decision support. As Ellemor (1998:26) emphasises, a researcher's representation of another individual's constructs will tend to differ, to varying extents, from the way in which that individual would represent themselves. Representation issues compounded when I sought to elicit constructions not only across cultures, but also across languages. Although I studied Thai language during my first year, my field experiences soon showed that my language proficiency was insufficient to rely on to yield detailed and still credible representations of the constructions of Thai-speaking stakeholders. Similarly, my lack of fluency with any of the tribal languages, or intimate knowledge of tribal cultures, provided a key

limitation in terms of representing the constructions of hill tribe villagers living in the highlands. Furthermore, time, funding and access constraints meant that I was unable to spend extensive time interacting with the latter groups. Consequently, this thesis focuses, in descending order of emphasis, on the Australian IWRAM collaborators, then Thai IWRAM collaborators (most of whom were fluent in English), then other highland stakeholders.

The Thai mode of testing the analytical framework, in which the three questionnaire sections of the framework were condensed into one interview guide, was more effective in providing insight into participants' construals than the Australian application. This was partly because the interview format enabled probing and thus facilitated more in-depth responses, and partly because participants' responses to questions from one section of the framework tended to reinforce and elaborate their responses to questions another section, thus providing a richer picture. Thus, in hindsight, the Australian mode of testing the framework may have benefited from a similar approach.

The quality of interaction in the group dialogues in both Australia and Thailand was limited by time constraints which arose when one or more participants arrived late, while others were required to leave early. In the Australian instance, continuity was compromised by breaking the dialogues into three sessions. To address both of these problems, a better method may have been to frame the group dialogues as a formal half-day workshop, rather than as a series of short, semi-formal meetings.

The method I employed to code and analyse interviews, questionnaires and dialogue transcripts was time and labour intensive, and would be cumbersome if a larger group of participants was involved. Firstly, the computer I was using had difficulties coping with the size of the coded tables and frequently crashed. Secondly, I treated each transcript intensively to ensure that all potential coding categories which emerged from the data were given consideration. Preparation of the coding frame on the basis of a smaller sample of transcripts would have saved time, but would not have yielded as rich an analysis.

2.10 Summary

The methodological approach of this thesis emphasises critical thinking, reflexivity, transdisciplinarity and constructive research. The research design of this thesis evolved through a complex and dynamic interplay between substantive theorising, emerging from my practical experiences with the IWRAM project, and conceptual concerns. Rather than predetermining methods, I allowed the gradual unravelling of the research problem to guide the selection of methods, which were drawn from a range of socio-political fields of inquiry. Participant-observation, document analysis, interviews, dialogues, questionnaires and meta-analysis were among the suite of methods used to gain insight into how decision support development might be reconstructed, how participants in the IWRAM project construed decision support, and the usefulness of my proposed framework for interrogating bias.

Environmental decision support systems

In the past decade, deforestation of the northern highlands of Thailand has become a contentious political issue, and has been widely blamed for exacerbating both drought and flooding in the lowlands.

3. Environmental decision support systems

3.1 Introduction

Through policies aimed at implementing or furthering the Rio Declaration, Agenda 21 and related conventions, many governments have formalised their commitment to a sustainability paradigm. However, the operationalisation within public policymaking of the principles of sustainability, and of its managerial adjunct Integrated Environmental Management (IEM), has proved challenging. In recent years, the development and application of computer-based Decision Support Systems (DSS) has increasingly been promoted to assist in resolving the dilemma of translating IEM theory into practice.

Through challenging and critiquing the conventional rationale for environmental DSS, this chapter argues that an unreflexive approach to the design of environmental DSS, which neglects the potential for bias, may serve to undermine effective IEM. Thus, this chapter paves the way for Chapter 4, which explores a framework to anticipate, interrogate and make more transparent existing or potential biases within a particular DSS. Section 3.2 outlines the conventional rationale for environmental DSS. Section 3.3 challenges the purported objectivity of DSS, and proposes a taxonomy of bias relevant to DSS. Section 3.4 examines the notion of DSS as expertise, and suggests that the reification of science and technology as the most authoritative and reliable basis for decision-making is undermined by local critiques of universal knowledge. Drawing on theory of the democratisation of expertise, Section 3.4 also discusses the potential for and limitations of a more participatory approach to the development of DSS in terms of assisting in managing for bias and ignorance. Section 3.5 argues that claims of the efficacy of DSS are undermined by anecdotal evidence that instances of sustained adoption of DSS by targeted users are more the exception than the rule. Section 3.5 further argues that recognition and management of bias is imperative not only from an equity and transparency viewpoint, but also for the effective and efficient provision of decision support.

3.2 Conventional environmental DSS

According to the conventional rationale for environmental DSS, due to cognitive limitations, humans have difficulty in coping with the complexity of modern environmental decision-making. As decision-making tasks become more difficult and unwieldy, "selective perception, selective information retrieval, incomplete or biased problem definitions, and unreliable or inconsistent evaluation of alternatives" arise, leading to "suboptimal decisions" (Lein 1997:95-96). It is argued that, due to its information processing capabilities, computer-based DSS may enhance the cognitive abilities of environmental decisionmakers to allow consideration of a more comprehensive range of variables more objectively (Stuth and Stafford-Smith 1993). Environmental DSS may thus render practical a range of vital but manually inefficient management techniques. By consolidating optimal knowledge, DSS may also enable decision-makers to undertake specialist analysis which they would otherwise be unable to perform due to a lack of the appropriate skills, knowledge or

experience. As Sagheb-Tehrani (1993:15) comments in reference to the utility of expert systems: "As good human experts are expensive, these systems provide an economical and efficient way of using the expertise in a variety of tasks".

In light of their perceived objectivity, expertise and efficiency, environmental DSS are increasingly being heralded within research and management spheres as critical for effective decision-making for sustainability (Mikolajuk 1996:3). On the surface, and according to the conventional rhetoric, DSS appears a vital tool to enable decision-makers to cope efficiently with the demands of sustainability. As Walker and Johnson (1996:175) comment, addressing the utility of DSS to assist Total Catchment Management in Australia, "it is hard to see how increasingly demanding objectives in environmental management could be achieved without effective and efficient use of information technology tools". Implicit within the conventional rationale are fundamental assumptions about knowledge claims, including the reification of science and technology as objective and expert. The rest of this chapter will characterise and critically examine these assumptions, and explore the implications of this critique for the effective provision of environmental decision support.

3.3 DSS, objectivity and bias

3.3.1 Reexamining the objectivity of DSS

DSS proponents' claims of objectivity are derived from a positivist notion of the scientific basis of DSS. As Ozawa (1996:221) comments, "Science is conceived as a process that yields an objective, rational, politically neutral body of knowledge". A key philosophical thread underlying this positivist conception is the dominant early Enlightenment perspective which promoted scientific knowledge revealed through a process of disciplined, deductive reasoning as certain and unbiased by prejudicial, precipitant or distorted information acquired via the subjective senses (cf Descartes 1968:41, Discourse 2). Rational inquiry was presumed to enable a disengaging of the mind from the body from the world (Appfel-Marglin 1996:3). This rationalist perspective was subsequently challenged by the Enlightenment empiricists, who argued that human cognition is necessarily grounded in sensory experience, and that the mind builds conceptual understanding by reflection on sensory impressions (Locke 1894:33, II.i). According to the empiricist perspective, the human mind cannot possess certain knowledge of the world, but can only speculate or infer probable truths on the basis of hypotheses concerning sensory impressions of reality (Tarnas 1991:334).

A resolution to the dichotomy between empiricism and rationalism was proposed by Kant, who argued that a person's perceptions of the natural world are channelled through *a priori* filters into a structure which reflects that person's prior knowledge and conceptual judgements about the natural world. On the one hand, this conception is consistent with the empiricist notion that humans cannot know an external objective reality without reference to sensory experience. However, it also appeals to rationality, by implying that reason exists as a part of the transcendental structures of cognition through which the human mind bestows order on the phenomenal world (Morrow 1994:147). Thus, "knowledge is made - constructed -

through synthesis, which is performed by applying the categories of pure understanding to what is perceived" (Spivey 1997:6).

The Kantian notions of mental filters and the constructedness of realities are echoed in the many variants of contemporary constructivist theory. For example, following Kelly (1955:8-9), personal construct theorists argue that a person can only know the world through patterns or templates, called 'constructs', which that person creates and then attempts to fit over the realities of which the world is composed. Social constructionists emphasise knowledge, including the common-sense knowledge that guides conduct in everyday life (Berger and Luckmann 1966, Gergen 1985, Geertz 1993:76), as generated from within social frameworks and as both constrained and enabled by "interlocking social commitments and conventions" (Wynne 1992:116).

Although individual-oriented and socially-oriented constructivism have traditionally been portrayed as distinct and even conflicting bodies of theory (Shwandt 1994:131), their compatibility is now widely recognised, and differences between the perspectives are regarded as predominantly a matter of analytic focus (Spivey 1997:25). Whether the analytic emphasis is placed on the individual or the social group, personal and social variants of constructivism are predicated on the Kantian notion that knowledge is constructed rather than discovered. From this starting point, contemporary constructivists have developed a comprehensive critique of the innate objectivity of scientific knowledge. Constructivists note that an important corollary of Kantian post-empiricism is that human observations are never free of priorly imposed conceptual judgements. Consequently, all knowledge "bears the marks of its constructors" (Code 1991:55). Wright (1992:27) explains the basic thesis:

> "we can observe and conceptualise the world only by imposing some general explanatory structure on our experience of the world, thus enabling the experience to be organised into observations and concepts. We can see only what in some sense we already expect to see, and so observations can never be truly pristine, never fully independent of our prior theoretical commitments and expectations. For this reason,... we can never have direct and innocent knowledge of an independent and objective world".

In the face of the constructivist challenge to the objectivity of scientific knowledge, Popper, although recognising that "We do not know: we can only guess" (Popper 1968:278), has maintained that 'good' science proceeds from an interest in "objective scientific theories - in the theories themselves, and in the problem of their truth, or their nearness to the truth" (Popper 1994:56). According to this orthodox perspective, the method of science, the method of rational critical discussion of competing theories, provides the one superordinate discourse to transcend different social frameworks towards the goal of realising certain truths. Thus, even if scientific fashion, ideological dogmatism, institutional convention or other sociocultural commitments serve to bias a theory, that bias will be exposed by competing theories. The theory which has the least bias or uncertainty, which is more objectively nearer to the truth, will succeed as the interim 'truth'. Note that within the positivist conception, 'bias' is construed as a negative term denoting divergence from 'the truth'.

However, numerous authors have challenged the presupposition that good scientists conform to Popper's ideal. In his seminal analysis of the structure of scientific

revolutions, Kuhn (1962:24) argues that scientists typically work to reinforce the prevailing orthodoxy, disregarding facts which do not fit pre-existing theory as anomalies. Kuhn's analysis of 'paradigms', his description of 'interim truths', shifted attention away from the prevailing framing of scientific research as a rational, logical process towards a notion of research as part of a cultural practice based on common meta-theoretical assumptions about the nature of science and methodology, key research problems, and exemplary science (Morrow 1994:74). Rather than viewing subjective construction as bad science, Wynne (1992a:115) argues that social commitments are a necessary feature of structured scientific investigation in that they define the boundaries of, and give coherence to, scientific knowledge. Similarly, Maturana (1991:31) holds that the criterion of validation of scientific explanations constitutes science as a particular explanatory domain.

Over the past two decades, numerous analyses, particularly from the sociology of scientific knowledge, have supported the argument that the technical construction of scientific logics is shaped by implicit and explicit social mechanisms of closure endemic to the culture of the observer (Collins 1986, Latour and Woolgar 1979, Wynne 1992a, Knorr-Cetina 1981, Yearley 1988). As Harding (1998:134) notes, from the outset of research, "it is in the context of discovery that culture-wide assumptions shape the very statement and design of the research project, and therefore select the methods". Latour and Woolgar (1979) detail the integral role that social microprocesses play in the social construction of scientific 'facts' during routine research in a scientific laboratory. Munda et al. (1994) point to the model designer's value judgement in selecting and weighting criteria in qualitative multicriteria model. Smithson (1989:8) emphasises the role of taboo as a form of socially enforced irrelevance: "taboo matters are literally what people must not know or even inquire about". These and other analyses support Ozawa's (1996:225) conclusion that "Irrespective of the rigidities of the scientific method, a multitude of discretionary judgements are made during the course of a scientific investigation by the researcher".

The interpretative flexibility of scientific logics is highlighted by 'expert disagreement' during episodes of scientific controversy (Pinch and Bijker 1987:27, Collingridge and Reeve 1986:16-17). In relation to divergent scientific explanations for radiocaesium contamination, Wynne (1992a:122,125) suggests that the research speciality of different scientists influences their construction of scientific logics: "Their epistemic, theoretical and methodological commitments build up different bodies of 'natural' data or facts, impregnated with incompatible 'natural' logics". Even within a research discipline or subdiscipline, multiple epistemologies tend to result in a multiplicity of concurrent competing theories, none of which has achieved the hegemonic status of a definitive, universal paradigm (Long 1992:17). As Geertz (1993:14) argues, "The various disciplines and sub-disciplines that make up the arts and sciences are, for those caught up in them, far more than a set of technical tasks and vocational obligations; they are cultural frames in terms of which attitudes are formed and lives conducted".

Additionally, when science encounters the public policy arena, whether during development or application of a theoretical concept or a scientific artefact (technology), then political factors such as expediency, interests and budgetary concerns emerge as a significant influence over the nature of the science or

technology (Lafollette and Stine 1991). For example, in reference to guided research funding, Shackley et al. (1995:221) argue that "the dominant agendas, commitments and goals of particular policy communities may themselves act as closure mechanisms around particular scientific styles, practices and predispositions". The potential for both policy relevant science and technological development to be shaped by explicit and conscious influence to further a group or individual's interests is illustrated in King and Kraemer's (1993:34) exposition of how opposing political parties in the United States have been routinely constructing their own economic models since the early 1980s to provide proof of the validity of their economic policies. In this instance, science and technology emerge "as weapons in ideological, partisan and bureaucratic warfare over fundamental issues of public policy" (King and Kraemer 1993:34).

Note that the preceding discussion illustrates the inadequacy of the conventional model which separates science from political ideology by positing the science and policy domains as independent systems which interact through the flow of information (Shackley et al. 1995:219). One modification to the conventional perspective suggests a distinction between core science (politically neutral and objective) and policy relevant science. Weinberg's (1972) trans-science model postulates the existence of a trans-scientific domain distinct from pure science encompassing policy-relevant scientific questions which requires non-scientific methods for resolution. Subsequent authors have elaborated on Weinberg, identifying domains of regulatory science and mandated science (Shackley et al. 1995:219). This thesis will not delve into these models other than to note that studies from the sociology of science would seem to undermine the trans-science models also, by revealing as artificial the reification of a politically neutral and objective core science. Regardless, even if the trans-science model is subscribed to, the science which underlies environmental decision-making clearly falls within the policy relevant domain.

In a similar manner to Shackley et al. (1995), Fries (1988:258) discusses how development of NASA's space stations "has not been a coherent design evolution by an intrinsic technological rationality but rather a series of ingenious contrivances to solve problems that were political in origin". Fries (1988:237) draws an analogy between technological development and Lindblom's (1959) model of public policy which argues that political decision-making tends to follow a process of "muddling through" rather than systematic, rational actions to achieve predetermined goals. This points to the historic specificity of technological development decisions, and supports Woolgar's (1987:312) comment that "there is no unique way of designing (or interpreting) technology. Designs and interpretations vary across time and among different social groups. When competing views and ideas come into conflict, the upshot of the ensuing controversy is determined by various social contingencies".

In summary, the conventional treatment of DSS as able to provide objective apolitical solutions stems from a unitary conception of knowledge which forces divergent knowledge claims into a homogeneous formalisation, overlooking "the way observations, insights, and ideas are influenced by interest and position" (Torgerson and Paehlke 1990:9). As Segal (1994:7) notes, "Because of its inherent contradictions and elusiveness, the public interest can never be defined technologically". Assertions of the objectivity of DSS thus neglect sociopolitical

heterogeneity, and are undermined by the theory of the social construction of knowledge.

3.3.2 Environmental DSS and embedded bias

The preceding analysis suggests that the knowledge embodied within a DSS (for instance, the underlying conceptual theory, the way the problem is defined, the parameters and data selected as relevant, the theoretical models favoured, or the options or what-if scenarios permitted by the system to be modelled) will reflect, perhaps inadvertently, networks of social commitments and conventions which arise from the values, priorities, experience and organisational culture of those who have input into or influence over the design or development of the technology (Bardwell 1991:605, Wynne 1992a).

Environmental decision-making is seldom unpoliticised (Di Chiro 1987). Instead, normative and political pluralism tend to result in multiple and competing definitions of environmental problems and their attributes (Miller 1993, Bardwell 1991:605). Consequently, an environmental DSS, designed to address a particular environmental problem, during a particular time period, at a particular scale, or within a particular boundary, will tend to be tailored to and therefore favour the worldview of those stakeholders who participate in or have influence over its design or who are the implicit users[5]. As Feenberg's (1995:12) analysis of the subversive rationalisation of technologies suggests, the DSS "offers a material validation of the cultural horizon to which it has been preformed". Where the construction of the DSS systematically influences the output, we can conceptualise bias as having been embedded into the structure of the DSS. Thus, in contrast to the positivist definition, 'bias' is now reframed as a relative term, indicating the promotion of (elements of) one constructed worldview over another, rather than divergence from 'the truth'. As Postman (1992:13) argues, "embedded in every tool is an ideological bias, a predisposition to construct the world as one thing rather than another, to value one thing over another, to amplify one sense or skill or attitude more loudly than another". A DSS may thus be considered as confining and enclosing dimensions of the decision-making environment through commitments to a system, or system components, and to the underlying logics.

A key source of embedded bias in environmental DSS arises from the limitations of the models incorporated within the system in representing complex, dynamic ecosystems. In describing environmental phenomena, a modeller attempts to abstract salient trends and patterns from a complex tangle of information (Malayang 1996). Any abstraction necessitates discretionary judgements on the part of the researcher. The model thus represents one perspective of elements and relationships within the ecosystem; the full spatial and temporal complexity of the environment is not able (nor intended) to be represented. As Torgerson (1994:307,308) notes,

> "Even if one takes for granted many conventional assumptions concerning the conceptualisation and categorisation of phenomena, there are always more variables

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[5] An important caveat to this point is that given the potential for bias to arise implicitly and unconsciously it is possible for a stakeholder participating in the design process to unwittingly discriminate against their conscious interests where these interests conflict with more tacit social commitments.

> than can be identified, much less measured with any precision, or even counted. This inexhaustibility and ambiguity, while possibly obscured through precise operationalisations and measurements in narrowly defined contexts, nonetheless becomes obvious when one tries to the imagine the sum of all innovations and their relationships".

Clearly, which knowledge representations are included, as well as which are excluded, will influence the output of the technology, and may therefore be conceptualised as a form of embedded bias.

The task of translating scientific knowledge to a computer-based DSS may necessitate further abstraction processes. Firstly, attempting to incorporate all known parameters would not only be time-consuming for programmers and require vast processing power, but may also compound uncertainty as the interactive effects of multiple variables are often turbulent and unpredictable (Carley and Christie 1992:71). Secondly, given that a computer-based model comprises a set of computable mathematical relations, the descriptions of environmental phenomena embodied within that model are influenced by the ease of representation of those phenomena as calculable, quantifiable variables. Variables less amenable to computational treatment, such as intrinsic significance, cultural traditions or political motivations tend not to be taken into consideration. The systematic non-incorporation of certain variables represents a crucial case of embedded bias through absence of knowledge. Responding to pressures for more integrative, holistic DSS, developers are attempting to cope with this limitation by refining methods of quantifying qualitative variables or formalising human constructs. However, this may introduce a further source of bias where the symbolic representation of these variables is inadequate, cursory, simplistic or misleading. Following Smithson (1991:10), we may conceptualise this as embedded bias due to the distortion of knowledge.

A further example of distortion of knowledge may emerge when either novelty or surprise lead to a new or altered decision environment. In focussing on the solution of ill-structured problems, rather than simple, bounded problems, DSS aims to support a dynamic, evolving decision environment. Thus, Abel et al. (1996:1) comment that "problem solving... typically requires some creativity and is essentially open-ended in terms of the data needed and the processing to be performed". In this context, Laacke (1995:126) warns that "the more integrated [DSS] becomes, the more difficult and expensive it becomes to adapt to different environmental conditions and changing user needs". In response to the tension between comprehensiveness (minimal absences in knowledge) and flexibility, DSS are increasingly based on a toolkit philosophy whereby users can select and link up relevant databases, models and visualisation systems as required. Despite this approach, limitations remain in terms of coping with novelty. Once resources have been invested into the construction of a particular technological system, it may be costly, both in terms of cash outflow and the opportunity cost of lost productivity, to make substantial structural modifications. As a result, it is often not possible to subject a technological system to the same rate of modification as the refinement of a theoretical construct.

The potential for embedded bias through absences or distortions in knowledge is amplified when an environmental DSS includes predictive modelling of future states. As Laacke (1995:115) asserts, "natural, dynamic, open systems present a serious philosophical and conceptual hurdle to the development of the very predictive models upon which the process of ecosystem management depends, because these models are probably impossible to validate or verify". The extent to which environmental predictive modelling engages ignorance and indeterminacy is illustrated by vigorous debate within catchment modelling literature over model verification and sources of error. Jakeman (1997) emphasises that "Catchment modelling has not progressed to the point where the effects of changes in land cover and management on erosion, water supply and quality can be accurately predicted unless the period of observation of quantities needed to calibrate a relevant model encompasses the range of changes to be addressed". In an environmental policy context, in which process complexity, data paucity and error are more often the rule than the exception, accurate prediction tends to be precluded. While conventions of practice produce assessments of uncertainty, this does not diminish the potential for embedded bias. Pervasive ignorance and indeterminacy ensure that only a restricted range of uncertainties are identified (Wynne 1992b:115). Furthermore, like the primary knowledge to which they refer, those uncertainties which are specified are also socially constructed and conditional.

The preceding analysis argues that a DSS will embody a particular sociopolitical perspective of environmental decision-making. The embodied perspective will be influenced by the networks of commitments of the developers and intended users, as well as the structure of the DSS which shapes permissible representations. When a DSS embodies a particular perspective from amongst a multitude of possible configurations, then presenting that DSS as objective and politically neutral acts to privilege the embodied sociocultural reality. The incorporated models, variables, data, scales, and so on, are sanctioned as truths, or legitimated as mechanisms which may acquire or determine truths. Excluded knowledge claims and methodologies are disempowered by their absence. In this manner, the reification of an objective DSS emerges as a cultural resource in the production of truths and construction of power. As Foucault (1980:113) argues, " 'Truth' is to be understood as a system of ordered procedures for the production, regulation, distribution, circulation and operation of statements. 'Truth' is linked in a circular relation with systems of power which produce and sustain it, and to effects of power which it induces and which extend it". The presentation of DSS as objective provides currency in claims for authority, reinforcing the credence of true, rational solutions. Unreflective reliance on DSS to provide objective solutions to environmental problems is not only politically naive, but may serve to obfuscate the political, cultural and moral dimensions of environmental decision-making.

Given the dialectic relationship between DSS and the social world, not only is a DSS shaped by social construction, but the introduction of a DSS into a decision-making environment may also effect a reconstitution of that decision-making environment. It may alter what we focus on as relevant, it may alter the symbols or means of decision-making, or it may alter the relationships between actors in the decision-making environment (Postman 1992:20). I argue that the obfuscation of the existence of embedded bias in DSS, and of the potential for embedded bias to interact

in a transformative way with the decision-making environment, is problematic within an IEM paradigm, creating tensions with equity and transparency dimensions. As Ewing et al. (1997:12) note, tools such as DSS which assist in analysing the larger quantity of information associated with an IEM approach do not by themselves constitute IEM. If DSS is to be an effective tool to assist IEM, it is imperative that tensions between the use of DSS and substantive dimensions of IEM, such as equity, transparency and a recognition of multiple perspectives, are attended to and reconciled.

3.3.3 Access as a source of bias

Analyses of the role of science and technology in politics reinforce the potential for science and technology to be appropriated "for constructing political authority and legitimating the exercise of political power" (Ezrahi 1990:preface). In a case study of adaptive management of the Columbia River basin, McLain and Lee (1996:443) observe that "scientific information has become a key weapon in the political struggles... Stakeholders who have the capacity to produce and analyse scientific data are in a much more powerful position than those who do not". Thus, if DSS constitutes a discursive method for validating one perspective over another, then inequalities in access to the technology, or to the processes in which it is embedded, may introduce, reinforce or augment power inequities between stakeholders.

The notion of geographical and financial attributes as potential sources of biases in access was the product of vigorous debate during the 1970s and early 1980s over the likely implications of computerisation for centralisation or decentralisation of decision-making. Initially, opinions were polarised. Echoing Orwell's Big Brother thesis, Whisler (1970), Mowshowitz (1976), Burnham (1980) and others argued that the application of computer-based technology tended to encourage, stabilise and entrench centralised social and political power structures and would thereby contribute to the erosion of the power of the citizenry. Providing support for this perspective, Wiezenbaum (1976:31) discussed how the computer had played a significant role in conserving, perpetuating and strengthening a centralised social welfare system in the United States because the information processing capabilities of the computer had made the mass handling of information required for centralised administration a practical and efficient technique. However, the claims that computerisation encouraged centralisation were rejected by others who contended that computer networking has the potential to support local autonomy and counteract flows of power to the central agency, by facilitating greater input from those lower in the organisational hierarchy (Hiltz and Turoff 1978:198).

By the mid-1980s, a dominant perspective had emerged, pioneered by Nora and Minc (1980), among others, that computer technology could be instrumental in shifting the balance of decision-making power in favour of centralisation or decentralisation dependent on the contextual structure of the technology. It was argued that large-scale, expensive, centrally located information systems would tend to promote centralisation, while a network of inexpensive computer terminals would tend to act as a decentralising force. The rationale for this argument derives from the information-as-power axiom that informed decision-making requires access to information and thus those who have greater access to information will have greater power over decision-making. In summary, the crux of the centralisation-

decentralisation argument was perceived to hinge on whether the computer technology was constructed to channel information to a central body or to local stakeholders.

In terms of environmental DSS, the preceding argument raises the potential for geographic and financial biases of access to be introduced through the construction of the DSS. In the case of an expensive, centrally located system, access would be limited for potential users who live in remote areas and have limited financial resources at their disposal to fund travel or compensate time away from productive work. However, these constraints may be alleviated if a terminal, from which the central system may be accessed, is provided to the remote user.

Even if a DSS is set up such that remote access to the system is available, access to the information might still be constrained if the conventional or computer literacy required to use the system is greater than that of the user. In response to this problem, DSS developers are increasingly placing an emphasis in user interface design on intuitive natural language dialogue facilities and visual presentation of system responses which are comprehensible to all users (Mikolajuk 1996:10). However, even if the user-friendliness of a system is sufficiently high for a user with a low degree of computer literacy to use the technology, inequities in terms of access to information may still be introduced, if awareness and comprehension of embedded assumptions is not consistent across users. If a user lacks sufficient traditional, scientific or computer literacy to understand how variables within the system translate to the contextual environmental problem under investigation, and to appreciate how embedded assumptions may influence the system output, then their capacity for informed participation is clearly limited relative to a more computer-literate user. Note that the former user is also vulnerable to manipulation by the latter user. As Lowi (1975:457) warns, "Many will know how, yet few will know. Those who know will be setting the agenda for - i.e., programming - those who only know how".

Mason (1986:53) argues that poorer groups are most likely to be disadvantaged in terms of computer literacy, as computer literacy tends to be a function of economic status as well as knowledge. In the West, the proliferation of low cost personal computers over the past decade has made computer-based technology more accessible and economically attainable even to lower income earners. This may explain the dearth of literature discussing computer literacy and access to computer based technology since the late 1980s. Nonetheless, the early analyses suggest that the lowest income earners would still tend to be excluded from these opportunities, particularly in poorer developing countries.

Although limiting stakeholders' access to information may inhibit the extent to which they are able to participate in decision-making, access to information is not necessarily an inroad to a gain in decision-making power. To illustrate the limitations of the information-as-power axiom, and to foreshadow ensuing arguments, consider a land use planning system which is located on a workstation in the central office of a government agency[6]. We will assume that the land use

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[6] This scenario is modified and extended from a discussion of a medical diagnostic system in Johnson (1985).

planning system contains geographically referenced databases and models which predict ecological health on the basis of ecological indicators. These databases and models have been selected and developed according to specifications set by the central agency. Via a remote terminal, a user representing the local community enters information on the ecological indicators of their catchment. Based on this input, the computer outputs various land use patterns and their likely ecological impacts, from which the local community may debate and select their preferred land management option. The DSS thus provides the community with information which would otherwise only be available to the central agency. According to the information-as-power axiom, the system would appear to facilitate an increase in local decision-making power. However, if the system was programmed to prescribe a single land use plan which the community was required to follow, then the system would clearly be supporting central control of decision-making. If the system output consisted of a ranked list of land use plans, and the community felt obliged to select the first-ranked option for fear that selection of the others might result in political repercussions, then centralised decision-making power would again be supported. Alternatively, if the local community was reluctant to base decisions on the system output because of a lack of trust in the technology, then the provision of information to the community via that technology would not lead to an increase in decision-making power. Finally, if the output of the technology overloaded the community with diverse and detailed information, and the community was overwhelmed and sidetracked into focussing on peripheral and less important details, rather than the central issues, then local empowerment would again be defeated. Clearly, "deconcentrated computerization does not itself guarantee a broader deconcentration of reponsibilities" (Nora and Minc 1980:54). As Weizenbaum (1984:38) argues:

> "There is a myth that computers are today making important decisions of the kind that were earlier made by people... But the widely believed picture of managers typing questions of the form "What shall we do know?" into their computers and then waiting for their computers to "decide" is largely wrong. What is happening instead is that people have turned the processing of information on which decisions must be based over to enormously complex computer systems. They have... reserved for themselves the right to make decisions based on the outcome of such computing processes. People are thus able to maintain the illusion, and it is often just that, that they are after all the decisionmakers. But... a computer system that permits the asking of only certain sorts of questions, that accepts only certain kinds of "data", and that cannot even in principle be understood by those who rely on it, such a computer system has effectively closed many doors that were open before it was installed".

In reference to the power impacts of automated information systems, Kling (1974:6) argues that "gains in power are modulated by the scope of power and authority of the information receivers relative to the actions they would prefer to take". This sentiment has been echoed more recently by McLain and Lee (1996:438), who comment that "The ability of institutions to respond to new knowledge depends on whether they have access to information and whether they have the will and capacity to act on that information". Meanwhile, Carr (1994:358) notes that "Just because community groups have the opportunity to become involved in environmental management does not mean that there is automatic problem ownership and

development of local solutions". These analyses emphasise that differences in political power, motivation and capacity create differences in the extent to which different actors participate in environmental policymaking. Where these differences exist independent of the introduction of DSS, then they may be considered irrelevant to a taxonomy of bias for DSS. However, pertinent bias emerges if a DSS introduces or exacerbates differences in political power or will, or if the DSS subsumes or supersedes alternate avenues of participation. To illustrate the latter case, consider a stakeholder who wishes to participate in environmental policymaking but who is either unable to use the DSS, for the reasons outlined previously, or who is uninterested or unwilling to use DSS, for example, because the system is perceived to be irrelevant. If the DSS has subsumed or superseded alternate avenues of participation previously open to that stakeholder, then the introduction of the technology has effectively limited their opportunities to participate in policymaking.

3.4 Taxonomy of bias

To summarise the preceding discussion of DSS and bias, a DSS system may be described as biased if the use of that technology systematically promotes one perspective over another, either because the output of the technology favours or promotes elements of one perspective over another, or because the use of the technology limits certain stakeholders' opportunities to participate in policymaking. Bias is thus defined as a relational term, not inherently held, but emerging from interactions between alternate practices, discourses and world views.

Friedman et al. (1996) propose a framework which categorises ways in which bias can arise in the design of computer systems. Three categories of bias are identified: preexisting bias; technical bias; and emergent bias. Preexisting biases are derived from social institutions, practices, and attitudes, and "exist independently and prior to the creation of the system... [they may] enter a system through the explicit and conscious efforts of individuals or institutions, or implicitly and unconsciously, even in spite of the best of intentions" (p. 333). Technical bias "arises from the resolution of issues in the technical design", and includes: limitations of computer tools such as hardware, software, and peripherals; decontextualised algorithms; imperfections in pseudo random number generation; and attempts to quantify the qualitative, discretize the continuous, or formalise the nonformal (p. 335). Emergent bias refers to bias that arises in the context of use. It includes: the emergence of new knowledge in society that is not incorporated within the system; the knowledge base of users being different from that assumed in the design; and the values of users being different from that assumed in design (p. 335).

The emphasis in Friedman et al.'s (1996) framework is on technical improvement of a computer system. The framework offers no guidelines on coping with bias where that bias is not suitable to technical remedy. Furthermore, the categories of bias which it proposes are not adequate to deal with many of the sources of bias relevant to DSS which have been discussed in the preceding pages. For example, Friedman et al. (1996) note the use by non-experts of the system as a source of bias, since non-experts would be more inclined to accept decisively the program's output. They classify this as emergent bias, since they assume that the system's designers had created the system with expert users in mind. However, the user-friendliness dilemma (that the process of designing a system for a non-expert serves to shield the

user from the underlying assumptions) is not addressed, nor does it appear to align with any of the framework categories. Secondly, while attempts to make human constructs amenable to computers is recognised within the framework as a bias, the non-incorporation of those constructs is not explicitly recognised as a bias. Thus, while the framework proposed by Friedman et al. (1996) represents a significant contribution, it emerges as inadequate to capture key sources of bias in relation to environmental DSS.

Distilling and synthesising factors which emerged from the earlier review as significant, Table 3.1 proposes a taxonomy of bias relevant to the design and use of environmental DSS. Part I of the taxonomy identifies three sources of bias in terms of the output of the technology. The first type of bias arises from conscious or unconscious commitments which influence the construction of the DSS, including commitments to: a particular DSS, for example, in the case of purchase of an off-the-shelf system; system components incorporated within the modelbase or database; or logics underpinning the system, including framing of either the problem or the options available to resolve the problem. Drawing on Smithson's (1991) taxonomy of ignorance, illustrated in Table 3.2, two further sources of biases in output are identified: incomplete knowledge; and distorted knowledge. Incomplete knowledge may arise through absence of knowledge, such as the nonincorporation of qualitative factors, or through the noncommunication of the uncertainties in knowledge. Distortions in knowledge encompass both inaccuracy (distortion in degree) or confusion (wrongful substitution in kind) (Smithson 1991:10). Examples of biases due to distortion include the inadequate quantification of qualitative factors, perceived misrepresentation of ecosystem processes, or the underestimation of uncertainties. It should be emphasised that the proposed taxonomy of biases in output diverges from Smithson's taxonomy of ignorance in terms of the inclusion of commitments and the exclusion of Smithson's concept of irrelevance. The former distinction arises because consideration of bias differs from ignorance in that it is not only the exclusion or distortion of knowledge that is significant, but also the inclusion and validation of certain perspectives. The latter distinction arises because I argue that irrelevance, the act of ignoring certain knowledge, is a judgement which may manifest within the DSS as incomplete knowledge.

In addition to biases in output, four sources of biases in access are identified in Part II of the taxonomy. The first three sources of bias relate to the ability of a stakeholder to access the DSS. The first source of bias identified is the geographical structure of the DSS, in particular, whether the DSS is only accessible at certain locations. The second source of bias identified is the financial cost of use of the DSS, including costs associated with purchasing, establishing and maintaining the system. The third source of bias pertains to the conventional, scientific and computer literacy of a stakeholder in relation to that required to use and understand potential biases in the output of the technology. The final source of bias identified raises the potential for the DSS to limit a stakeholder's opportunities to participate in decision-making by introducing or exacerbating differences in political power or motivation, or by subsuming or superseding alternate avenues of participation.

I) Sources of biased output:

Commitments (conscious or unconscious)
- Commitment to a particular system
- Commitment to particular system components
- Commitment to the logics underpinning the system

Incomplete knowledge
- Absence
- Uncertainties

Distortion of knowledge
- Confusion
- Inaccuracy

II) Sources of biased access:

Geographical considerations
- Central location vs network

Financial considerations
- Cost of purchasing or establishing the system
- Cost of ongoing use of the system

Literacy
- Literacy required to use the technology
- Literacy required to appreciate potential biases

Political considerations
- DSS introduces/exacerbates differences in political power/motivation
- DSS subsumes/supersedes alternate avenues of participation

Table 3-1 Taxonomy of bias associated with environmental DSS

Ignorance	
Error Incompleteness Absence Uncertainty Distortion Confusion Inaccuracy	Irrelevance Untopicality Taboo Undecidability

Table 3-2 Taxonomy of ignorance: Smithson (1991) (Abbreviated)

3.5 DSS as conditional expertise

A key thread to the conventional rationale for DSS is the purported capacity of DSS to embody and impart expertise. Yet intended users seem less convinced than developers of the expertise of DSS since anecdotal instances of targeted users disregarding DSS use abound. Technology transfer and extension literature suggests that the DSS experience is one manifestation of a broader tension between alternate conceptions of valid claims to knowing. In the following sections, I explore these alternate conceptions and their implications for DSS use and development.

3.5.1 DSS and the expert culture

The epistemological legacy of the Enlightenment conceptions of science, technology and nature is reflected in contemporary 'expert culture' or 'technocratic' approaches to environmental management. An intertwining of science and public accountability was consolidated during the Enlightenment. According to the medieval Christian view, the universe was both created and continuously and personally governed by an omnipotent God (Tarnas 1991:285). Within this paradigm, theology and natural magic furnished a model of accountability of government based on transcendental referents to divine grace (Ezrahi 1990:61-66). Inspired by the Scientific Revolution, Bacon and other Enlightenment scholars mounted a comprehensive challenge against theologically shrouded and driven science. They argued and popularised modern secular scientism, the independence of secular scientific knowledge from sacred religious beliefs (Olson 1982:Ch 9). As trust in magic as a mechanism of accountability declined, attention deflected to the rigour and logic of science as the basis of a framework against which to validate and legitimise rational political action. Science was perceived to yield universal truths, and thereby privileged as the standard against which other forms of knowledge were assessed (Murdoch and Clark 1994:119). This universality underpins modern scientific expertise, which is presumed to be fundamentally non-local (Giddens 1994:84).

In parallel with the establishment of science as universal arbiter, Enlightenment scholars also posited scientific inquiry and technological application as the means by which humans could achieve mastery over an external nature (Carley and Christie 1992:69). Over the ensuing centuries, scientific expertise became increasingly linked to a preoccupation with rational management, control and prediction of the environment (Norgaard 1994:64). During the 1970s and 1980s, confidence in the capacity of scientific expertise and technologies to dominate and transform nature led many to dispute emerging analyses by Ehrlich and others that signalled ecological limits to growth (Dryzek 1997). As the environmental problematique gained currency, the expert culture reconstituted in the form of technocratic environmentalism, which seeks second-order control: "a higher level of observation and intervention has to be installed, in order to control the consequences of the control over nature" (Sachs 1993:20). From this standpoint, responding to the ecological predicament entails "regulating the transformation of nature globally in an optimal fashion" (Sachs 1993:20). Through references to predictive modelling of the impacts of management activities, evaluating trade-offs between different management strategies, and optimising management actions (e.g Bettinger et al. 1996), the conventional framing of DSS resonates firmly with the technocratic, expert culture paradigm.

Within the expert paradigm, an important corollary to the reification of scientific knowledge is a marginalisation of alternate bodies of knowledge. If science, as the "intellectual construction of general regularities" (Ezrahi 1990:49), yields universal truths and provides grounds for universal actions, then science may confidently override alternate claims to knowing (Apffel-Marglin 1996:2, D'Souza 1994:92). This premise underpins modernisation theory, which visualises development in terms of a progressive movement towards more complex, sophisticated and integrated forms of 'modern' society through transfers of technology, knowledge and resources from the 'developed' to the 'developing' (Long 1992:18-19). Particularly post-WWII, modernisation theory was embraced as a model of development by the bureaucracies of many non-Western countries (Norgaard 1994:52). Within the extension field, modernisation theory provided the basis for the linear, 'science-push' model which emphasised the transfer of western scientific expertise, often embodied within agricultural technology, to farmers in order to transform their primitive and inadequate traditional practices (Ewing et al. 1997:1). Under this paradigm, local communities were treated as passive recipients of expert scientific advice and technology (Kloppenburg 1991:523). During the 1970s, low rates of technology adoption under the science-push model led to a broad anxiety amongst policymakers and scientists about the community's inability or irrational unwillingness to accept 'correct' scientific information. Instances of public distrust of scientific knowledge were often regarded as stemming from stoic ignorance.

3.5.2 Expertise as conditional: The local knowledge critique

Over the past two decades, a shift in rural sociology, development studies and agricultural extension theory has provided an alternate perspective on the technology transfer approach. Firstly, since the mid-1970s, the universality of scientific expertise has been challenged by grounded analyses of the efficacy and impacts of transferred technologies. These analyses argue that not only have transferred technologies often failed to deliver their promised rewards, but that the uncritical transposition of western scientific conceptions of and approaches to environmental management has itself contributed to environmental degradation and social disintegration (Marglin 1996, Redclift and Woodgate 1994:64). Chambers (1997:31,33) attributes these failures or 'development errors' to the physical, organisational, social and cognitive distance of professional scientific experts from the local, complex, diverse, dynamic and unpredictable realities of the people and conditions that they were analysing, planning and prescribing for, and making predictions about.

Postcolonial analyses of development further argue that conventional technology transfer represents a cultural process of domination whereby local people are expected to conform to an imported and imposed blueprint conceived by enlightened authorities. From this perspective, technology transfer presents as a disempowering and anti-democratic process which denies individual autonomy and increases local dependency (Gorz 1993:57, Yearley 1988:150). The logic of the scientific method is not perceived to lend universality. Instead, the scientific framework is cast as a colonising tool which invades local realities, reconstructing them via the imposition of abstract categories. This process is seen to render formulations based on quantification and economic evaluation valid, and to marginalise those stemming

from intuition and practical experience, which are aligned with local, non-scientific ways of knowing. One local-centred response to the critique of inherent scientific expertise is to emphasise and value local or 'indigenous' ways of knowing which are argued to be embedded within the contextual decision-making environment. Another, championed by Schumacher (1974) and McRobie (1982), is to develop 'appropriate' technology which is better suited to the needs and specificities of local decision-making environments.

Literature examining public attitudes towards science observes that scientific knowledge (as well as the technology which embodies that knowledge, institutions which promote that knowledge and decisions made on the basis of that knowledge) may suffer a public loss of credibility and support if the community perceives that the 'expert' knowledge is irrelevant to or incompatible with their local realities. For example, in a case study of Cumbrian sheep farmers' scepticism of scientific advice about restrictions introduced after the Chernobyl radioactive fallout, Wynne (1992a) suggests that distrust was partially shaped by the perception that scientists had made incorrect or overly simplistic assumptions about complex, diverse local environments. In particular, scientific explanations on which initial policy commitments were made were later retracted after they were found to be based on a false model of the behaviour of caesium in upland environments; the standardisation by scientists of local physical environmental variations, farming conditions and practices was perceived by farmers to yield management advice ignorant of local heterogeneity; and scientists' denial of farmer's knowledge of hill-farming management realities led to unrealistic experimental conditions which later necessitated the abandonment of the experiments (Wynne 1992a:286-297).

Beyond reinforcing the fallibility of scientific pretensions to universal expertise, the Cumbrian example illustrates that, like knowledge, interpretations of 'expertise' are multiple and socially constructed. Validation of expertise, or who is qualified to know, is seen to engage different validation codes dependent on the validator. Expertise is revealed as conditional, and contingent upon the realities of the observer. Validation of knowledge and expertise emerges as a dynamic negotiation between social actors and networks, rather than a linear and deterministic 'transfer' of knowledge commodities. Note that from this standpoint, refusal to 'adopt' external interventions may be interpreted as a viable discursive strategy by which 'intended users' may actively engage in the (in)validation of knowledge.

Recent contributions to development literature have critiqued the local-centred analyses for overplaying the distinctions between 'local' and 'scientific' knowledges by reinforcing a dichotomy between embedded, practical local knowledge and abstract, disembedded scientific knowledge (Murdoch and Clark 1994). Firstly, as discussed in the preceding critique of objectivity, accounts from the sociology of scientific knowledge have emphasised that all knowledge generation, including that effected by 'scientists', may be regarded as a contextual process embedded within specific sociocultural networks (Kloppenburg 1991:529, Watson-Verran and Turnbull 1995). The categorisation of scientific knowledge as disembedded from social relations is thus inconsistent with evidence of the constructedness of scientific theories and logics. None-the-less, it remains that abstraction, generalisation and the discovery of invariant laws are explicit methodological and epistemological goals of western science (Latour 1986). Furthermore, a particular scientific explanation will

be contingent on the networks of the constructing scientists, rather than necessarily those of the community in which the scientific explanation is being applied. Secondly, rigid distinctions between local and scientific knowledges become less tenable when one recognises the centuries of interactions between local and scientific ways of knowing through which these knowledges have reflexively exchanged, transformed, learnt and evolved (Agrawal 1995:422). Furthermore, application of scientific models is often physically contextualised through the imputation of locally-derived values for model parameters. These criticisms of the local-centred analysis, however, do not negate the argument that the 'expert solutions' proffered by particular scientists for a particular community may not be construed as 'expert' by that community.

3.5.3 Reconstructing expertise

If interpretations of expertise are accepted as multiple and socially constructed, then, drawing on Chambers (1997), a key question is 'whose definition of expertise counts?'. Challenging the notion of self-proclaimed and un(der)validated expertise, cultural theorists argue that public knowledge should be evaluated and validated as part of the broader social system that creates and sustains it (Rayner 1992:98). As O'Hara (1996:101) argues, "As long as discourse remains limited to experts who represent the mainstream of disciplinary (or interdisciplinary) thinking, the discourse process may simply reinforce biases of the status quo as familiar definitions of critical rationality remain unchallenged". A similar theme is discernible within contemporary public policy, risk analysis, adaptive management and rural development discourses (McLain and Lee 1996:439, Wynne 1992a:126, Torgerson and Paehlke 1990:9).

For example, in Funtowicz and Ravetz's (1991) post-normal paradigm, 'extended peer communities' are promoted for "quality assurance" of scientific methods and interpretations. Funtowicz and Ravetz (1991,1995) argue that this democratisation of science is "necessary for the effectiveness of science in meeting the challenges of global environmental problems" (1995:160), and represents "the creation of a system which in spite of its inefficiencies is the most effective means for avoiding the disasters that in our environmental affairs... result from the prolonged stifling of criticism" (1991:151). They thus argue that empathetic or local knowledge may assist in managing scientific distortion or ignorance and thereby may enrich a scientific description: "Knowledge of local conditions may not merely shape the policy problems, it can also determine which data is strong and relevant. Such knowledge cannot be the exclusive property of experts whose training and employment inclines them to abstract, generalised conceptions. Those whose lives and livelihood depend on the solution of the problems will have a keen awareness of how general principles are realised in their 'back yards' " (1991:149).

In light of recent attacks on the sociology of science as aiming to denigrate science (Gross and Levitt 1994), it should also be noted that arguments in favour of the democratisation of expertise do not tend to equate with negation of scientific methodology and practice (Kloppenburg 1991:525). Nor does a democratised position necessarily argue that scientific knowledge has an inherently lesser claim to knowledge. Instead, most advocates of democratised expertise merely propose that the institutionalisation of an exaggerated faith in the scope, power and certainty of

scientific knowledge be replaced by a more reflexive and critical approach which recognises the partiality of a scientific perspective (Carley and Christie 1992:66, Busch 1984). In this vein, Wynne (1992a:115) argues that "the built-in ignorance of science towards its own limiting commitments and assumptions is a problem only when external commitments are built on it as if such intrinsic limitations did not exist". The intent behind a democratised approach is to manage bias by avoiding "an overdependence on particular ways of understanding and blindspots through the exclusion of other ways of knowing" (Norgaard 1994:10).

Furthermore, democratisation of expertise does not necessarily imply that any claim to knowing, however ludicrous, should be uncritically accorded status as expertise for public policymaking. As Harding (1998:19) warns, "Not all proposed standards of knowledge are equally good - indeed, some are not only inadequate, but dangerous". Many advocates of democratisation support positioned rationalities, described by Haraway (1995:181) as "an argument for situated and embodied knowledges and an argument against various forms of unlocatable, and so irresponsible, knowledge claims". Others emphasise the precepts of Habermas' communicative rationality as procedural criteria to guide the resolution of contested claims to knowing (Habermas 1984, Dryzek 1990:87). From either standpoint, rather than submitting to ethical or normative relativism, the community of interest legitimises claims to expertise according to their negotiated code for assessing claims to knowing.

What insights does the preceding reconstruction of expertise offer in terms of improving the capacity of DSS to promote more transparent, accountable, and equitable policymaking? It suggests that if DSS is developed only by an elite technical or epistemic group according to the conventional paradigm then assumptions and uncertainties should be open to scrutiny by the communities of interest. One approach to meeting this directive prescribes that developers provide documentation to the community of interest specifying the assumptions and uncertainties associated with their system. Some DSS, such as RAISON and LUPIS, are now promoted as featuring the capability for users to gain access to underlying assumptions such as technical details about models, the rule base and how inferences were made (Lam et al. 1994:512). A limitation of this approach is that some assumptions, such as those due to ignorance or tacit normative codes, will be beyond the developers' awareness, rendering communication nonsensical. Further limitations derive from difficulties in the extent to which uncertainties may be characterised.

A second approach encourages critical scrutiny by interested parties of the documentation and the hard code of the system. As King and Kraemer (1993:356) argue, "The critics can then question why certain variables are included versus excluded, or why this variable is treated exogenously versus endogenously, or why variables are weighed as they are. The model provides a systematic argument for and against various biases by its very nature. The model becomes the Rosetta Stone by which policy analysts with different biases can speak a common language to debate critical assumptions". In this way, a role is framed for DSS which emphasises use of the technology to clarify issues, channel discussion, identify common ground and both encourage and enforce a discipline of analysis and discourse (King and Kraemer 1993:356). A drawback of this approach lies in the difficulty external interested

parties face when attempting to illuminate the logic underlying the actions of computer systems. As Cleland and MacKenzie (1996:370) note, "designers typically rely as much (or more) on intuition, experience and simulation as they do on mathematics". Meanwhile, Friedman and Nissenbaum (1996:331) argue that "biases in computer systems can be difficult to identify let alone remedy because of the way the technology engages and extenuates them... If the system is complex, and most are, biases can remain hidden in code, difficult to pinpoint or explicate".

3.5.4 Participatory design

An alternative approach is a more participatory mode of design, construction, and development of DSS, in which only knowledge already validated by the community of interest as relevant and credible be incorporated within the DSS. Participatory development of scientific models has been a recurrent theme since the late 1960s. In Britain, Mumford and Ward (1968) and others at the Manchester Business School explored a socio-technical approach to participative design of data processing systems. During the early 1970s, an influential Scandinavian approach to participatory, democratised systems design evolved based on strong union involvement (Ehn and Kyng 1987:25). Within an American policy context, Straus (1979:663) advocated a discursive process for model design, involving data mediation and participatory model building, as a means to expose normative assumptions embedded within the model and thereby better manage complexity: "The very act of trying to seek agreement on the data, and to build the model... will force us to better understand the viewpoints of our opponents and, conversely, help our opponents understand our viewpoint and, if performed with integrity and intelligence, it should improve predicability and accuracy". According to this perspective, a participatory approach may provide a forum for stakeholder learning, as well as assist in managing for bias and thereby enhance the quality and credibility of the DSS.

Straus' emphasis on communicative learning within participatory design has been echoed within recent DSS literature. Angehrn and Jelassi (1994:270) propose reconstructing DSS development to produce "a different type of DSS whose main objective is to provide flexible environments through which learning about a decision situation can take place". Drawing on the experience of developing a DSS for sustainable management of grazing lands, Bellamy and Lowes (1995:111) argue that a focus in DSS development on support for learning processes "can create opportunities to foster communication and integrated action across a range of diverse stakeholder groups". In this context, there has been increasing emphasis in user interface design on intuitive, natural language dialogue facilities and visual presentation of system responses which are comprehensible to novice as well as experienced users (Mikolajuk 1996:10). Fedra (1995:5, 15) advocates a heuristic role for environmental DSS, whereby the DSS provides "a common, shared information basis, framework, and language for dialogue and negotiation. The dialogue between the actors in the decision-making process is extended to a dialogue with the DSS, which plays the role of a technical expert and bookkeeper rather than an arbiter". Note that the knowledge embodied within the DSS continues to be framed as inherent expertise within the latter perspective

Fedra (1995:9) maintains that participatory development of DSS is valuable in that it increases users' ownership of the DSS and provides a measure of insurance against irrelevance. Marsden's (1994:53) comment in relation to indigenous participation in rural development appears pertinent here: "The assumption is that people will be more responsive if they are central to the design and implementation of programmes that affect their lives and livelihoods, and if they make some personal investment or commitment to them". However, increased ownership of decision-making processes, arising from participatory DSS development, does not necessarily translate to increased commitment to a software-based DSS. Instead, as Argent and Grayson (1997:200) illustrate, participation in the preliminary stages of DSS development may confirm to participants the valid outcome that a software-based DSS is technically or politically unnecessary or inappropriate.

While a participatory approach may appear upon initial appraisal to be an improvement on the conventional paradigm in terms of managing bias, and thereby enhancing the credibility, quality and relevance of decision support, it introduces new concerns. Central to these are questions such as who should participate, and when? On the one hand, unless the DSS is intended to address a defined problem at the micro scale with few stakeholders, logistical and financial constraints obviously preclude the participation of all stakeholders from the genesis of design. On the other, many stakeholders may elect not to participate, perhaps because of opposition to the DSS, apathy, distrust of the proponents of the DSS, or the personal costs of participation (cf Syme 1992:90,93). Also, it is not possible to identify and therefore to seek the participation of any future stakeholders who may later develop an interest in the problem. These questions are important since, as Norgaard (1994:151) notes, "Who participates and how they are allowed to participate determines the type of questions raised, information brought to the discourse, and judgements made and encouraged upon others to make". Who participates, and who does not, thus shapes and may bias the DSS development process and thereby the DSS.

Once participants have been engaged, a second issue arises concerning the form and process of participation, especially the politics of negotiating consensual knowledge and democratised expertise. As Scoones and Thompson (1994:21) note, "knowledge, which is diffuse and fragmentary, emerges as a product of the discontinuous and inequitable interactions between... competing actors. Through their respective 'discursive' networks, different kinds of information and processes are communicated and legitimated. Misunderstanding and apprehension over hidden agendas and manoeuvres for power are the rule, not the exception". Long and Villareal (1994:49) argue that "Knowledge processes are embedded in social processes that imply aspects of power, authority, and legitimation; and they are just as likely to reflect and contribute to the conflict between social groups as they are to lead to the establishment of common perceptions and interests". These perspectives provide a warning that participatory development of DSS, albeit underpinned by democratisation theory, is no methodological panacea to rid knowledge production and transformation of political subjugation, obfuscation, or coercion. Indeed, unreflexive recourse to participatory approaches may merely provide a smokescreen for battles over knowledge claims and systemic biases.

Rather than being treated as a homogeneous, standard approach, participatory development of DSS should be recognised as encompassing a multiplicity of forms

reflecting different conceptions of participation, and different power/knowledge relationships. For example, consultation by DSS developers with a small group of client users regarding technical specifications will involve different systems of power and knowledge legitimation to a process in which all stakeholders potentially affected by the DSS are engaged in dialogue about conceptual construction of the DSS. As discussed in the earlier discussion of decentralisation, there are also important power/knowledge implications if people are expected to participate in ways that are beyond their capacity or resources, if the scope for choices in development is constrained, or if they are not aware of alternatives (cf Williams 1987:89). Drawing on the Scandinavian democratised systems design experience, Ehn and Kyng (1987:40,43) raise power/knowledge implications if inadequate time is afforded for union representatives to fully explore their perspectives before a systems design decision is required, and if the union representatives acquire the language, attitudes and values of the technical design experts, distancing themselves from their constituents. Recognition of both the heterogeneity of participatory approaches and the potential for bias urges critical appraisal of each instant of participatory DSS development in terms of the systems of power engaged and their roles in shaping the representations of knowledge embedded within the DSS.

As a further illustration of how bias may manifest within a participatory approach, consider a DSS development project that endeavours to recognise multiple perspectives by incorporating both 'local' and 'scientific' forms of knowledge within a DSS (cf Bosch et al. 1996). In this approach, bias may arise if 'local knowledge' is treated as a coherent, unitary and fixed product that may be unproblematically detached from the dynamic social networks which create and sustain that knowledge, and easily assimilated into a western scientific framework (Scoones and Thompson 1994:21, Murdoch and Clark 1994:118). Beyond neglecting the multiple and evolutionary nature of local knowledges, this approach may require the locally-derived knowledge to be manipulated into a form amenable to incorporation within a DSS framework, thereby paving the way for absences and distortions in knowledge. In this vein, Turnbull (1998) discusses how Australian Aboriginal knowledge about sacred sites was straightjacketed to fit a cartesian GIS. Attempts to incorporate multiple forms of knowledge within a DSS may also serve to reinforce traditional dichotomies between universal scientific knowledge and local knowledge. For example, 'local knowledge' may be confined to the provision of ecological baseline data while the models and theories underpinning the interpretation and manipulation of that data remain the domain of western science. Thus, based on a subjective categorisation of knowledges, 'local knowledge' is validated to provide information on local resources, but science is legitimated for global understanding and control.

In summary, through incorporating a wider range of worldviews, histories, knowledge horizons, a participatory approach to developing DSS may assist in managing bias associated with development by an elite and relatively homogeneous technical or epistemic group. However, given the limits to participation, some degree of bias in DSS development is inevitable. Furthermore, participatory approaches should not be viewed as a means to escape bias, since they too are inherently political processes in which validation of the structure, form and content of the DSS is enmeshed in systems of power.

3.6 From (in)efficiency to effective decision support

According to classic DSS theory, DSS should promote effective rather than just efficient decision-making (Sprague 1982). In practice, rhetorical justification of DSS frequently highlights efficiency as a key rationale for investment in and application of DSS. Claims of the efficiency of DSS conventionally stem from the capability of computers to speed up the processing and transformation of information. However, as Cleaves (1995:87) notes, "Computerized aids are most helpful in easing the costs and in speeding up the decision process, but don't necessarily help improve decision quality unless their designs consider the needs and eccentricities of human judgement and decision processes". In their exploration of the long-term effectiveness of DSS on decision outcomes, Barr and Sharda (1997:144) concluded that while the use of DSS tended to decrease the time decision-makers spent processing information, its effectiveness was more limited in terms of promoting an increased understanding of relationships between decision-making parameters. Barr and Sharda (1997:134,143) also observed that the efficiency gains often encouraged a reliance on DSS such that decision-makers would habitually defer the decision-making process to the computer, decreasing those decision-makers' effectiveness in future decisions. Hence, calculative efficiency does not necessarily promote long-term efficacy.

Furthermore, while few DSS developers admit it publicly, privately a number have acknowledged that a mismatch often arises between the DSS that the technical experts provide, and the DSS that intended users are willing to use. Fedra (1995:5) notes that although environmental DSS "have been discussed and advocated for a considerable time... Success stories of actual use in the public debate and policymaking processes are somewhat more rare". Clearly, if significant resources are expended on development of a DSS that is disregarded by intended users, then both efficiency and efficacy claims are seriously undermined.

A key question that arises is: what makes an environmental DSS an effective tool for users? The earlier discussion regarding the inadequacies of the technology transfer model suggest that the relevance of the DSS to the decision-making environment of the intended user is critical. This is supported by recent DSS literature. For example, Moreno-Sanchez et al. (1997:164) suggest that "System development efforts that are technology-driven rather than end-user-demand driven are less likely to succeed". Ewing et al. (1997:3) argue that "In the past, many DSS-style models have been unattractive because they are either 'black box' models that hide critical assumptions about the way the system functions or are so abstract as to ignore many of the political realities of decision making". The latter comment highlights a common critique that conventional DSS, premised upon a model of decision-making as an objective, technical exercise, is irrelevant to contemporary environmental decision-making which often entails apparently "eclectic, fuzzy and shifty compromise between competing interests" (Ezrahi 1994:32). As Norgaard (1994:144) notes, "Political choices must be made using criteria other than a weighing of expected benefits and costs of mechanically predicted, patently unlikely, futures".

Undermining relevance, and echoing a trend evident in a broad spectrum of computer application and innovation research, conventional DSS development has often favoured construction of a generic product in response to developers' perceptions of

users' needs rather than supporting the specific characteristics and needs of the decision-making or management environment (Argent and Grayson 1997:199). As participatory DSS development gains currency, the increased participation of users in defining the scope and focus of a DSS emerges as a strategy to confront the inefficiency dilemma, by enabling management questions to take primacy over software system provision (Argent and Grayson 1997:204).

As discussed earlier, giving primacy to the needs and interests of the users and decision-making environment may lead to the conclusion that a computer-based DSS is redundant for the issue at hand. For example, it may emerge that the existing decision-making processes are adequate in light of the type of decisions, information requirements and the stakeholders involved, and would not be improved through introduction of a DSS. Alternately, the decision requirements may preclude efficient use of a computer-based DSS. For example, occasional or one-off decision tasks tend to be less amenable to efficient use of DSS than routine, frequent and standardised tasks (cf Walker and Johnson 1996). The extent of knowledge about ecosystem processes and the availability and accessibility of data may also influence whether a computer-based DSS is judged a useful tool. For instance, Gough and Ward (1996:14) concluded that a DSS would not be an appropriate tool to assist management of Lake Ellesmere, in New Zealand, because "Until such time as comprehensive databases containing information about the biological and ecological processes in the lake and the impacts of changes can be established, there are too many sources of uncertainty associated with the types of decisions that are required to be made to make DSS either a useful or viable option". In other situations, a highly user-friendly DSS incorporating simple relationships may be deemed sufficient for the decision at hand and suited to the literacy characteristics of users, and therefore development of a more complex and sophisticated DSS would be unwarranted and inefficient. Thus, as Argent and Grayson (1997:199) contend, "while software tools can be important components of a decision-making process, their role must be carefully considered in the light of the overall management objectives and the audience for the exercise". In other words, effective decision support requires cognisance of the pertinent decision-making environment[7]. In this context, a conversational approach to DSS design, as advocated by Schon (Interviewed in Binder 1996:56), which engages developers in dialogue with potential users about how they construe decision support, may be useful.

However, engaging professional developers and users in dialogue about the potential relevance of a DSS is not a simple task. On the one hand, if DSS developers are motivated by an interest in refining a particular system, then they may be less inclined to spend substantial amounts of time considering the possibility that an alternate system or process would be more effective. Commitment to a dialogue on relevance would imply a reframing of the role of the DSS developer as supporting a situated decision-making environment by assisting decision-makers in exploring appropriate tools or mechanisms to support their practice. On the other hand, developers frequently note that users "may not fully understand or be able to articulate requirements early in the development cycle" (Moreno-Sanchez et al.

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[7] Consonant with this point, the case study for this thesis will open by exploring the decision-making environment of the highlands of Northern Thailand.

1997:165). Participatory DSS development thus tends to be more akin to Lindblom's (1959) "muddling-through" than Simon's (1957) model of rationality. Opportunities for on-going dialogue between users and developers are necessary if both groups are to establish a mutual understanding of users' needs and of the capability of the DSS to satisfy those needs.

It should be emphasised that the efficacy of a DSS is a dynamic quality, as the relevance of a DSS may be compromised due to distortions or absences in knowledge which arise through inflexibility of a DSS to respond to changes in the decision-making environment. As Torgerson and Paehlke (1990:9) note: "Knowledge is not something which can somewhere be insulated or enshrined, for - to be relevant - it depends always upon the context and dynamics of organizational activity" . Since the decision-making environment, including management objectives, decision options, sociopolitical networks, interested actors, and ecological processes, is not static, the decision support must co-evolve with the environment. As Moreno-Sanchez et al. (1997:164) observe, in the context of multi-media environmental GIS, systems "can easily become 'snapshots' of existing conditions and run the risk of becoming outdated shortly after completion". Against this background, sustained negotiation processes between users and professional developers emerge as useful to enable on-going dialogue about the dynamic efficacy of a DSS, including emerging biases.

As well as relevance, the credibility of a proposed DSS is also an important efficacy consideration. As alluded to during the discussion about expertise, intended users' cynicism about the purported neutrality and legitimacy of the knowledge or reality embodied within technology often fosters non-use. In reference to the introduction of systems models developed by the Bonneville Power Authority and the U.S. Army Corps of Engineers to inform management of the Columbia River Basin of systems models, McLain and Lee (1996:442) discuss how fish agencies and tribal authorities raised objections to use of the models because they perceived the models to be flawed in favour of hydropower interests. As above, the key is the extent to which users perceive that the functional relationships and other information incorporated within the DSS are pertinent and valid. In this context, the transparency and comprehensibility of the DSS, and thus literacy or communication biases, emerge as significant. As Laacke (1995:126) argues: "The function and output of each step must be understandable, and it must be credible both to those who will exercise it and to those who are concerned about the information it produces"[8]. Thus, the interrogation of potential biases during DSS development emerges as a dimension of satisfying equity and transparency dimensions of credibility, and is thereby important for effective - and efficient - delivery of decision support. While every DSS will be associated with some form of partiality and bias, the key question is whether the biases associated with a particular DSS are significant in light of stakeholders' concerns.

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[8] Laacke (1995:126) further argues that "A computer-based DSS that becomes so integrated and self-defining that it is not possible to track analyses from step to step, and understand the results, ceases to be credible". In this context, the original motivation for DSS to assist in the resolution of ill-structured problems may ironically undermine the credibility and thus efficacy of DSS as analysis of complex, ill-structured problems is inherently less intuitive and more difficult to comprehend than simple, well-structured problems.

3.7 Conclusions

Claims that DSS provides objective, expert solutions for environmental problems are undermined by social construction theory, and recognition of the interpretive flexibility of expertise. So long as DSS development remains in the hands of an elite technical or epistemic group, the knowledge embodied within the system, the system structure and the transformed knowledge (output) of the system will tend to conform to and reinforce the biases of this group. While opening the development process to a wider cross-section of stakeholders may assist in managing for bias and ignorance, the limits to and costs of participation, as well as the political nature of participatory approaches, dictate the necessity of approaches which recognise that bias is arguably impossible to avoid. Rather than viewing bias as a threatening and negative concept, I propose that critical reflection on bias during DSS development may enhance the efficacy of environmental decision support. A theoretical basis and analytic framework for interrogating the biases associated with a particular DSS will be proposed in Chapter 5.

From critique to progress: Reorienting DSS development

A number of ethnic minority 'hill tribes' live in the northern highlands of Thailand. Many lowland Thais blame the destructive agricultural practices of the hill tribes for highland environmental problems, and have placed pressures on the Thai government to forcibly relocate the hill tribes out of the highlands.

4. From critique to progress: Reorienting DSS development

4.1 Introduction

In response to the critique of conventional DSS presented in Chapter 3, this chapter explores a more reflexive process of DSS development which recognises the potential for bias. The initial part of this chapter draws on broader theoretical traditions to explore how the processes of DSS development may be recast to better recognise the role of values, interests and other discursive influences in the construction and use of DSS. Synthesising useful theoretical concepts from this discussion, Section 4.8 presents an analytical framework to facilitate interrogation of bias in DSS.

4.2 Reflexivity: Probing the frame

A starting point for a reorientation of DSS development is the notion of reflexivity, which has gained increasing attention over the past two decades as a response to the constructedness of knowledge (Morrow 1994:76). Within different theoretical traditions, reflexivity engages different sets of problems associated with the status of knowledge in relation to the knower or the observer (Steier 1991:2). Within ethnomethodology, the term reflexivity is used to refer to the "constitutive circularity of accounts" (Ashmore 1989:32), in that for a reader to make sense of an account, the reader must have some understanding of what the account refers to, which in turn requires the reader to have made sense of the account. Within sociology of science, the problematic of reflexivity applies to the reflexive relation between the subject of inquiry (science) and the methods of inquiry (scientifically-derived methodology), which is seen to undermine critical analysis (Gruenberg 1978). Reflexivity has also been used to refer to the self-confrontation of modernising societies with risks which are inadequately dealt with in industrial society (Beck 1994:5). My treatment of reflexivity differs from the preceding interpretations, although it shares their self-referential nature. Drawing on Hopper (1995) and Goffman (1974), *reflexivity is constructed as self-analysis and critique of the frames which guide the organisation or interpretation of knowledge.*

I argue that in order to confront the constructedness of DSS, the process of DSS development should be reconstituted as reflexive practice. Review of the DSS literature suggests that reflexivity has not yet emerged as a topic of concern, which is unsurprising as constructed knowledge has also received scant attention. Since DSS developers parallel, and are often drawn from, the academic community in terms of engaging in the construction of knowledge through research, development and application, I suggest that academic approaches to reflexivity may inform more reflexive DSS development.

Although reflexivity is receiving increasing theoretical treatment from academics, pragmatic approaches to reflexivity within academic culture have remained limited, with the bulk of academic culture appearing unaware, dismissive or in neglect of academic social construction (Hopper 1995:59). Within the academic domain,

serious recognition of reflexivity within analytical practice has been predominantly dealt with through experimental textual devices which seek to challenge and deconstruct the representational or interpretive nature of the constructed text (Ashmore 1989, Woolgar and Ashmore 1988, Mulkay 1984). These textual approaches to reflexivity have been critiqued by Hopper (1995:63, 65) as neglecting the role of cultural practices in the (re)production of academic knowledge through their exclusive focus on individual, authored representations. He further argues that such approaches are limited by the individual's inevitable blindness to fundamental dimensions of their personal framing, resulting in only a partial capacity to point to and analyse the frame (Hopper 1995:64). As an alternative to textualism, Hopper (1995:65) suggests that reflexivity should manifest as a collective process engaging the academic community in critical dialogue about the conditions and bases, beyond conventional epistemological concerns, that shape the construction of academic knowledge. Accepting Hopper's (1995) critique, reflexive DSS development may similarly be constituted through discursive rather than textual devices. Ensuing sections will explore and articulate a conceptual framework to guide a discursive approach to reflexive DSS development.

4.3 Precautionary practice: Managing bias

A compelling rationale for engaging in reflexive DSS development must provide the foundations of a conceptual framework. I argue that consideration of the precautionary principle provides such a rationale. The precautionary principle emerged in response to recognition that, given the complexity and dynamism of ecosystems, environmental decision-making often takes place in situations of pervasive and even irreducible uncertainty. As Dovers (1995a:15) comments, "we are unsure of rates and causes of environmental change, the implications of these changes for natural and human systems, and both the efficacy and socioeconomic impacts of policy measures". Environmental decision-making thus necessarily engages an element of risk and uncertainty. Traditional risk management has sought to reduce or preferably eliminate risk and uncertainty in the natural environment. However, increasing recognition of the unlikeliness of the total comprehension of natural systems, or human interactions with them, has led to increasing acceptance that where there is a threat of serious or irreversible environmental damage, measures to anticipate, avoid or minimise this damage should be attempted even in situations of incomplete knowledge (IGAE 1992:13). This is known as the precautionary principle.

Within policy spheres, the precautionary principle has been invoked to inform environmental management at local, national and intergovernmental levels, including the Rio Declaration on Environment and Development 1992, the United Nations Framework on Climate Change 1992, and the World Conservation Strategy 1991. While the precautionary principle does not provide pragmatic guidance, consensus has emerged in the literature that a precautionary approach should entail (Deville and Harding 1997, Dovers 1995b, Wynne 1992b):

- acknowledgment that uncertainty, ignorance and indeterminacy pervade our knowledge about the environment and environmental risks
- a shift in the onus of proof from those advocating environmental protection to those proposing actions that may impact the environment

- a proactive, preventative and anticipatory rather then reactive or defensive approach.

Shifting from consideration of externalised environmental threats to the risk that developers' practice may bias the DSS, with potentially serious and irreversible adverse implications for actors in the decision-making environment, I argue for a reflexive treatment of the precautionary principle by developers of environmental DSS, see Box 4.1. This shift from environmental impacts to the effects of practice is similar to a move from project-based Environmental Impact Assessments to Strategic Impact Assessments of policies, and thus may be termed a 'strategic' precautionary approach. Analogous to environmental risk management, precautionary practice would entail the anticipation, avoidance and minimisation of potential biases through critical reflection both prior to and during DSS design and development. Thus, rather than leaving users to manage the impacts of biases reactively as they manifest, DSS developers would assume a degree of responsibility for identifying, managing and communicating potential biases which may interact and transform the decision-making environment in ways judged adverse. In this manner, a precautionary approach shares similarities with the perspectives of Woodharper et al. (1996), Rogerson (1995) and others who have advocated the development or establishment of a code of ethics for information systems analysts. However, a precautionary approach differs significantly from much of the development ethics literature in emphasising communication of the critical history of DSS development including the discursive interrogation of biases. Thus, developers' consideration of bias is not confined to spheres of personal practice, and extends beyond the development community[9] to engage with the broader decision-making community.

Precautionary Principle	*Precautionary DSS development*
• concerned with threat of serious or irreversible environmental damage	• concerned with risk that biases may have serious or irreversible implications for decision-making environment
• anticipate, avoid and minimise damage	• anticipate, avoid and minimise biases
• proactive, preventative and anticipatory environmental management	• proactive, preventative and anticipatory DSS development
• onus of proof on those proposing actions that may impact environment	• greater responsibility on those developing DSS to identify, manage and communicate potential biases

Box 4-1 From the precautionary principle to precautionary DSS development

Beyond recognising that uncertainty, ignorance and indeterminacy may lead to embedded biases within the DSS, precautionary practice also recognises that technological commitments, made on the basis of presumed knowledge and manifested as components of the DSS, and policy commitments, made on the basis of users' presumptions about the validity/uncertainty of the DSS output, will both

[9] The term 'development community' refers to all of those who participate in DSS development, including conventional 'developers' as well as any participating 'users'.

serve to compound ignorance (cf Wynne 1992b:114). Acknowledgment that technological commitments may compound ignorance reinforces the imperative for developers to interrogate and manage biases during the design (conceptual commitment) and development (technical commitment) processes. Acknowledgment that policy commitments may compound ignorance reinforces the value in documenting and communicating developers' discursive interrogation of biases to users in order to alert them to potential biases due to technical commitments. Note that participatory development is also encouraged since involving users in development is likely to enhance their awareness of commitments and other sources of bias.

A precautionary approach to DSS development presupposes a dialectic co-constructive relationship between technology and society. On the one hand, the introduction of a DSS reconstitutes the decision-making environment, shifting and transforming relationships, networks and processes. On the other, the DSS is constructed and transformed by developers and other actors within the decision-making environment. Hence, while bias may be introduced through the social commitments of developers, and while this bias may interact transformatively with the decision-making environment with potentially adverse implications for stakeholder relationships, there is also an opportunity for DSS developers and users to anticipate and manage potential biases through value-sensitive development. If a DSS not only shapes, constrains and enables our decision-making actions, but developers and users may also shape, constrain and enable the DSS, then a space emerges for creative engagement with the DSS to guide it toward trajectories which reflect their negotiated vision. The interplay of technologies with society are always unpredictable, and precautionary practice is no panacea for unwelcome consequences. However, I suggest that iterative interrogation of biases is a key step in guiding the construction and use of DSS in a manner more consonant with a sustainability paradigm.

The proposed approach shares similarities with branches of Technology Assessment (TA) in terms of an interest in the sociocultural and political consequences of technologies, and in the constructive management to guide the development of technology which better meets social goals, namely sustainability (Porter 1995, Huddle 1972). However, by focussing on processes of social construction, the proposed approach differs significantly from conventional TA, which emphasises probabilistic assessment and deterministic forecasting of the impacts of a defined technology. Within the TA literature, social constructionist approaches are beginning to emerge, notably, Van Langenhove and Berloznik (1996). My proposed approach to reorient DSS development may be positioned within this nascent discourse.

4.4 Learning through reflection on practice

How should precautionary DSS development proceed? Literature which explores the relationship between practice, research and learning, particularly action learning literature, offers useful insights for more reflexive DSS development. Action learning is concerned with the dialectic between thought and action (Robottom 1987:109). It involves self-critical and socially-critical reflection on practice, and on the theory of practice, with an aim to improve practice (Di Chiro 1987:44). In

contrast with passive learning in which the learner receives knowledge imparted by an authority, action learning entails active reflection by the learner on their own practice.

While some (for example, Revans 1991) argue that an action learning mode is founded on taking action rather than discussing or recommending possible actions, most advocates recognise that action does not automatically lead to learning (Margerison 1991:213, Pedler 1991:63). Pedler (1991:63) suggests that the defining characteristic of action learning is not the requirement for action, but instead "acquiring the ability to ask good questions of oneself, of others and of situations which lead to an increased ability to tackle problems in the future". Within this conceptualisation of action learning, critical interrogation is emphasised in order to challenge the individual or group's presumed knowledge (ignorance).

A conceptual framework developed by Argyris and Schon (1974) to assist people in learning-directed reflection on their actions provides several key concepts underpinning action learning. Argyris and Schon (1974:7) distinguished 'theories of action', the theories of practice which a practitioner purports to subscribe to, from 'theories-in-use', the theories which frame the practitioners actions. They posited that theories-in-use captured the governing variables which a practitioner was interested in, and that these set boundaries for action (p 15). Based on this conceptualisation, behavioural learning was described as either the adoption of new strategies to achieve the existing governing variables (single-loop learning), or modification of the governing variables (double-loop learning) (p19). Argyris and Schon (1974:30, 31) suggested that double-loop learning tends to be initiated through the surfacing of dilemmas, such as observation of incongruities between the espoused theory of action and the theory-in-use. They further argued that any situation of practice provides opportunities for learning through examination of the assumptions underlying practice, and exploration of dilemmas of theories in practice (p 159). Over the past two decades, practitioners from a wide range of fields, particularly education and sociology, have drawn on these concepts of active reflection on one's own theory of situational practice, but often without Argyris and Schon's strict experimental methods of testability (Fook 1996, Sadique 1996, Ryan 1996).

In the context of DSS development, action learning offers a conceptual framework for self-examination of developer's practice and development biases through reflection on the assumptions and commitments which constitute practice, their potential manifestation within the DSS, and potential role in reproducing or transforming the decision-making environment. However, while action learning may be fostered, it cannot be guaranteed. As Pedler (1991:64) notes, "one of the critical prerequisites is whether the individual wants it to happen for her/him" (1991:64).

4.5 Collaborative learning

Although the principles of action research have been extrapolated to improvement of individual practice (Whitehead 1991), action research originally gained popularity, particularly through Lewin's (1946:34) work, as a tool to assist intergroup relations. Retaining this group focus, many advocates argue that action research is only constituted through collective and collaborative inquiry (Zuber-Skerritt 1992). Within this conception, action research requires an emphasis on forming shared

discourses and agreed practices, (self-)critical analysis of group relationships, and group learning (Kemmis and McTaggart 1988).

Kemmis and McTaggart (1988:31-43) invoke theories of contestation and institutionalisation to describe the dynamic of group learning. Contestation theory refers to the political processes of negotiation and renegotiation that effect change in a group's continual reconstruction of its social reality, and its relationship to broader society (p. 31). Thus, as DSS developers reflect on potential individual and shared biases, conflict may emerge, for example, as to the validity or likelihood of biases, or the practicality, necessity or means of managing biases. As contests between members of a group are resolved, certain discourses, practices and organisations become accepted, shared and institutionalised (p. 41). Kemmis and McTaggart argue that revelation of the critical history of contests, changes and institutionalisation is a key dimension of constructive group improvement, as the critical history may shape "categories of individual and cultural action to define themes, issues and strategies which could form the basis of a plan for a program of reform" (p 43). Learning is thus represented as directed improvement through individuals becoming more conscious and critical of the coherency and consistency of individual and shared discourses, practices and forms of organisation (p.44). As individuals reflect in concert, group learning may emerge. As Heclo (1974:306) argues, "Social learning is created only by individuals, but alone and in interactions these individuals acquire and produce changed patterns of collective action". Thus, the identities of DSS developers, and their constructions of bias, development practice, the DSS and the decision-making environment, are continually contested, reproduced and institutionalised. Reflection on the critical history of DSS development may catalyse individual learning, and may shape collective action, therein reinforcing collaborative learning.

Collaborative social learning also features in organisational change, policy learning and environmental negotiation literatures. From the organisational learning domain, Haas (1990) describes learning as "the establishment of shared meanings among parties that may be active antagonists but that find themselves condemned by their interdependence to negotiate better solutions than they had created in earlier attempts". In construction of knowledge terms, the establishment of shared meanings implies the sharing of different constructed realities. As Erlanson et al. (1993:24) note, "This sharing is never a straight-forward, clear communication of the original constructions; it is shaped by the host of realities already constructed by each group, based on their collective experiences as well as the relationships between the groups". The demand for procedures to negotiate a path through conflict for mutual social learning translates into a requirement for processes that interrogate and adjudicate the different construals of reality (Bruner 1990:95). As Long (1992:27) warns, such processes do not escape conflict, but instead are inherently political: "Knowledge encounters involve the struggle between actors who aim to enrol others in their 'projects', getting them to accept particular frames of meaning, winning them over to their point of view". Consequently, apparent convergence of constructions may reflect one person's successful impairment, perhaps via suppression, intimidation, distortion or obfuscation, of communication and other social interchanges intended to guide the negotiation of shared constructions (Lindblom 1990:80, Habermas 1984). From this perspective, non-collaborative learning may be

promoted as individuals or stakeholder groups engage in single-loop learning about how they may better achieve the ends defined by their core ontological and normative beliefs (Sabatier 1988, Jenkins-Smith and Sabatier 1994).

Lee (1993) draws on Haas (1990) and Argyris and Schon (1978), among others, in his model of social learning, based on adaptive management and bounded conflict, to achieve sustainable ecosystem management. Within Lee's conception, adaptive management involves the use of policy experimentation to discipline learning from experience (p. 114). Bounded conflict is represented as "a combination of politics, negotiation, and other means of promoting uncomfortable change, which provides tools for establishing shared goals and probing the bounds of cooperative effort" (p. 16). Lee argues that while social learning may emerge through conflict, severe conflict may prevent or undermine experiential learning, or lead to only sporadic learning (p. 101,114). To foster learning, Lee suggests restructuring conflict through negotiation processes which recognise different visions of conflict, and thus of learning directions, which build consensus on agreed goals, and which oversee incremental settlement of conflict (p. 105,108). Echoing Lee's approach, McLain and Lee (1996:439) propose that "In situations where a multiplicity of stakeholders are present, the key is not to try to reach consensus on all values and meanings but to create some common values and shared meanings through processes that promote the development of mutual recognition of the legitimacy of the interests of others". Focussing on individuals within communities of practice, O'Neill (1998:16) argues that differing understandings "only need to be addressed and resolved when they directly interfere with mutual engagement and achievement of the joint enterprise". To negotiate a convergent vision from divergent positions, Lindblom (1990) advocates social inquiry or 'probing' of the differing positions. These theoretical perspectives suggest that to promote collaborative learning, divergent framings of decision support should be highlighted, probed and debated when they manifest as competing claims for commitments in constructing the DSS developers' joint enterprise; the DSS.

Departing from conflict-oriented models, an alternative perspective on decision-making and group learning argues that learning not only flows from political contests, but also from "collective puzzlement" (Heclo 1974:305). Following this line, Revans (1991:5) suggests that collective learning flows from the recognition of common ignorance, as participants discover that no one participant can tell the others the answer, but instead "all are obliged to find it". Within this conception, learning entails taking steps to overcome ignorance, rather than merely trading knowledge between participants. This suggests that a condition for effective collective learning may be a willingness to acknowledge the limits of group knowledge and the existence of ignorance.

One challenge in collaborative learning is the potential for disjunctures when a newcomer joins the DSS development process. Situated learning theory offers insights into how new participants in the DSS development community may integrate with a culture of reflexive, precautionary practice. Following Lave and Wenger's (1991) conception, 'situated learning' implies more than classical experiential models of 'learning by doing'. Learning is framed as a process of becoming a full participant in a particular community of practice (Lave and Wenger 1991:52). Rather than merely acquiring skills and knowledge, the learner gradually absorbs and

becomes absorbed into the culture of practice - the norms and practices of the community (p. 95). The newcomer also introduces their personal culture of practice to the community of practice, therein reconstituting and transforming the community. Based on a conceptual understanding of agent, activity and social world as mutually constitutive, learning thus involves the (re)production, transformation and change of the identities of practitioners, skills of practice, and communities of practice through social activity (p. 49, 51). Differences in power between the established community members and the newcomer mediate the extent to which a newcomer reluctant to engage in reflexive, precautionary practice will transform or be transformed by the culture of practice (p. 116). It should be noted that, by locating learning as social co-participation, Lave and Wenger (1991) offer a contrasting viewpoint to Kemmis and McTaggart's (1988) and Heclo's (1974) analytical focus on the individual-as-learner.

4.6 Critical dialogue to interrogate biases

It should be noted that approaches to reflexivity which focus on shared construing may echo the limitations of participatory DSS development. For example, Gergen and Gergen (1991:86) propose a 'relational reflexivity' which focuses on shared construing of meaning and theory by researchers and research 'subjects'. Their account of relational reflexivity is intended to move beyond the limitations of the individual to realise and articulate the linguistic conventions in which he or she is embedded. However, while sharing realities may challenge the biases of the individual, like participatory development, this approach may fail to guard against reinforcement of the shared cultural biases of the group. To move beyond these limitations, the notion of reflexive practice adopted earlier suggests the necessity of a commitment beyond shared construing to critical, cyclical interrogation and communication of group biases as they are realised.

A number of authors from contemporary sociology and critical theory suggest that this task may be assisted by broader discursive interaction. These approaches resonate with Hopper's (1995:67) interest in critical dialogue to confront the cultural bases of knowledge reception and (re)production. For example, drawing on Habermas (1984), Dryzek (1990) argues for a revival of open political discourse for collective deliberation and decision-making, underpinned by communicative rationality. Communicative action is "oriented toward intersubjective understanding" and "the generation of action-oriented consensus" (Dryzek 1990:14,70). An action is communicatively rational depending upon the extent to which interaction is uncoerced, unconstrained, undistorted, and validated on the basis of argumentative speech (Habermas 1984:10). Dryzek (1990:87,221) recognises that purportedly discursively democratic exercises are as vulnerable to co-option and exploitation as conventional processes, reinforcing the imperative for continual critical scrutiny.

Drawing on Habermas (1983) and Dryzek (1990), O'Hara (1996) proposes an ethical discursive process for ecosystems valuation. O'Hara (1996:97,101) argues that discursive ethics offers: firstly, the potential for making visible or deconstructing valuation biases concealed by disciplinary assumptions and cultural norms; and secondly, a framework for a democratic reconstruction of deconstructed valuation and decision-making processes. The former process is engaged from the point of selection of discourse participants through consideration of the views of those who

are conventionally unheard and un(der)-represented. An expanded democratic dialogue may then give expression to the latter process. Extending Dryzek's warnings, O'Hara (1996:104) argues that critical sensitivity to hidden value distinctions and underlying biases is necessary in ecosystems' valuations to avoid reinforcement of existing valuation and power structures.

In terms of DSS development, the preceding perspectives support the incorporation of discursive processes to catalyse the critical interrogation of tacit and shared biases. Although critical dialogue has received limited attention to date within the DSS literature, a few authors have supported, in very general terms, a role for DSS in promoting or facilitating critical dialogue. For example, Fedra (1995:6) argues that the graphical user interface of a DSS "can generate a widely accepted and familiar format for a shared information basis supporting an open debate". O'Neill (1998) suggests that through modelling scenarios, DSS can help to situate shared visions, providing a focal point for negotiating common meanings. Addressing critical dialogue in greater detail, Angehrn and Jelassi (1994:270) describe a DSS which facilitates a critical interrogation of a user's biases by means of 'stimulus agents' programmed into the DSS: "These agents can be thought of as a team of advisors, experts and devil's advocates that challenge the frame selected by the decision maker. They provide different viewpoints and additional information and offer alternative problem solving strategies. As a result, the DSS user is prevented from structuring problems in too narrow a way, from becoming too overconfident in his or her judgement, and to eliminate (sic) or reduce the negative effects of other well-documented biases". This approach provides a virtual dialogue between the user and DSS developers, and its utility as a critical tool appears inversely dependent on the degree of consonance of the users' frame with the frames imputed by the developers. While an advance on conventional DSS usage, providing a restraint on hubris, this approach is less useful in terms of a critical reconstruction of the DSS development process, since introducing a second DSS to challenge development biases of the focal DSS could easily engage biases associated with the second DSS, perhaps exacerbating complexity and circularity. The fundamental problem is that, where it is even mentioned at all, the DSS literature treats bias as located in the user, and tends to neglect the role developers may play in biasing a DSS.

4.7 Weaving the threads: A new theoretical framework for DSS development

To confront the constructedness of DSS, and the concomitant potential for bias, the process of DSS development is reconstituted as reflexive, precautionary practice. Reflexive practice entails critical inquiry into, analysis of and reflection on practice to enable greater self-awareness of framing, accompanied by revelation of the influences of framing in shaping the process of knowledge (re)production. Precautionary practice involves the anticipation, avoidance and minimisation, both prior to and during DSS design and development, of potential biases likely to interact transformatively with the decision-making environment. A cyclical, discursive approach, based on principles of action learning, is proposed to guide self-examination of developer's practice and development biases through reflection on the assumptions and commitments which constitute practice, their potential manifestation within the DSS, and potential role in reproducing or transforming the decision-making environment.

As DSS developers reflect on potential individual and shared biases, individual learning may be catalysed as individuals become more conscious and critical of the coherency and consistency of individual and shared discourses, practices and forms of organisation. Inconsistent discourses, practices or forms of organisation may shape alternate framings of decision support, manifesting as competing claims for commitments in constructing the DSS. As individuals probe and debate divergent framings of decision support in concert, a mutual vision for the joint enterprise (the DSS) may be negotiated, and collaborative learning may emerge. As well as interrogation of divergence, critical scrutiny of convergent framings is advocated to challenge tacit and shared group biases. Communication of the critical history of DSS development is promoted to apprise future users of biases and commitments, and inform post-facto learning.

While critical sensitivity is increasingly informing natural resource management, witnessed by greater emphasis on equitable and participatory management strategies, it is not yet as visible reflexively within the personal and professional theory and practice of those who develop and enact approaches to natural resource management, including DSS developers. Within the DSS literature, reflexivity, critical practice, and the constructedness of DSS have received limited and inadequate attention. The theoretical framework articulated above thus provides a useful contribution to the DSS field.

4.8 Analytical framework: Anticipating and interrogating bias

The preceding review has established a theoretical basis to underpin the reorientation of DSS development as collective, collaborative learning via discursive interrogation of biases. However, with the exception of Anghen and Jelassi (1994), whose approach was inadequate for exploring developers' biases, the literature has not yielded analytical advice. Procedures are required which assist developers or users committed to or potentially affected by a particular DSS application to explore potential and existing biases associated with the DSS. To this end, Table 4.1 proposes a generic analytical framework, based on the taxonomy of bias presented in Chapter 3, which is intended to structure an interrogation of potential and existing biases associated with an environmental DSS.

The analytical framework is divided into three sections. **Part A is a background section** which situates the analysis within a specific decision-making environment. Question A1 queries the motivations for development of the DSS, in order to explore interests and commitments. By asking participants to detail the decision problem the DSS is being developed to support, A2 prompts broad problem-framing. A3 emphasises the evolving, dynamic nature of the decision-making environment, and is designed to inform subsequent reflection on embedded biases introduced through time. A4 explores the stakeholders who have an interest in the decision problem for which the DSS is being developed. A5 examines the policymaking processes which are deemed relevant to the decision problem, with a view to exploring how the DSS may alter stakeholders access to the policy process. A6 and A7 identify who the developers consider potential users' of the DSS, and the benefits they are expected to gain through use of the DSS, pointing to assumptions about the purpose of the DSS. A8 directs attention to the types of information which the developers consider necessary to be incorporated within the DSS, signalling problem-framing

assumptions. To delineate the perceived functional bounds of the DSS, if any, A9 examines whether the DSS will be introduced in conjunction with other types of policy mechanisms, such as non-computer-based operational policy frameworks. A10 inquires of the criteria for success of the DSS, prompting identification of further assumptions about the purpose of the DSS.

Part B is an interrogation of embedded bias. B1 deals with who the DSS developers are, and their varying roles in the development process. Beyond identifying the developers, B1 is intended to prompt reflection on the partiality of participation, and the different degrees of participation possible. Those stakeholders who have an interest in the decision problem, but who will not be involved in development of the DSS, are explicitly identified in B2. Thus, perspectives are located which will not be directly involved in development, pointing to potential embedded biases. B3 continues this line of reflection, exploring how these non-participating stakeholders' views, as well as those of participating stakeholders, are intended to be incorporated within the DSS. In particular, this may inform reflection on absences and distortions of representation. Question B4 examines problem framing in greater detail, and is intended to prompt developers to consider assumptions underpinning their problem framing and alternate perspectives. By exploring the capacity of the DSS to be updated or reconstructed, B5 focuses on the potential for management of biases such as absences or distortions in knowledge which may be introduced by the evolving decision-making environment. Pointing to developers' commitments to a particular system, system components or the logics underpinning the system, B6 identifies the hardware, software, models and datasets which are to be incorporated within the DSS. To catalyse reflection on assumptions made about relationships and interactions within the decision-making environment, B6 also examines the integration of components. To signal potential assumptions regarding relevance, and potential absences or distortions in knowledge, B7 focuses on those systems or components which may have been rejected by developers for inclusion in the DSS. B8 inquires about the uncertainties and assumptions which the developers are aware of in relation to the either the system components or underlying processes, suggesting potential biases due to distortions in knowledge. To explore potential absences or distortions in knowledge introduced as a result of the interface, in particular those due to the user-friendliness dilemma, B9 and B10 query the mode of presentation of the DSS output and associated uncertainties and assumptions.

Part C is an interrogation of biased access. To inform potential geographic biases in access, C1 queries the geographical structure of the DSS, for example, whether the system is intended to be centrally located or networked. C2 then compares the geographical structure of the DSS with the locational constraints of potential users. To inform potential financial biases in access, C3 queries the costs of developing/purchasing, establishing and maintaining the DSS, and who is likely to bear the costs. C4 then compares the financial costs of the DSS with the financial resources available to different potential users. To inform potential biases due to literacy, C5 and C6 explore the conventional, computer and scientific literacy which are anticipated to be necessary either to use the DSS, or to interrogate and analyse the potential for embedded biases. C7 then compares the literacy demands of the DSS with the literacy bounds of potential users. C8 aims to catalyse reflection on the interaction of the DSS with policymaking processes and institutions within the

decision-making environment, including whether the DSS is likely to supplement or supplant policymaking processes, or whether the DSS may serve to mediate either the empowerment or the disempowerment of an institution or stakeholder group. Given the existing policymaking processes, and the potential geographic, financial, literacy and political biases in access, C9 and C10 explore whether the use of the DSS is likely to improve or worsen the access of any of the stakeholders in environmental decision-making.

For any application, it is likely that certain questions proposed may be deemed irrelevant or inadequate. Thus, to ensure relevance and practical feasibility, the generic framework (including the wording of questions and the methods of application) should be modified to suit each specific case. The framework is not intended as a prescriptive methodology, but rather as a flexible yet detailed guide to stimulate critical reflection on and discussion of biases. If used early, the framework may facilitate the anticipation of biases, thus allowing the management of potential biases before they emerge as problems. It should be emphasised that the framework is intended as an iterative heuristic aid, with developers and users revisiting questions periodically throughout the development and use process. If reapplied throughout the design, development and implementation of the DSS, the reflective responses may provide a (partial) history of the rationale underlying design, development or implementation decisions, thus facilitating a more transparent process. This may prove useful where a participatory approach is limited, allowing scrutiny after the fact of the underlying logic and assumptions. It may also prove useful to guard against loss of critical history if key participants in development decisions leave the DSS development community.

4.9 Conclusions

This chapter has outlined the conceptual underpinnings of a new approach to DSS development, which emphasises a precautionary treatment of development biases. The anticipation and management of biases is cast as an iterative process of critical reflection on development practice, the DSS, and the decision-making environment. Through this process, individual and collaborative learning emerge, as the DSS, DSS development practice, and the identities of DSS development participants are reproduced and transformed. To catalyse and guide reflexive interrogation of biases, a heuristic analytical framework has been proposed. In order to ground and further develop both the conceptual and analytical frameworks, in subsequent chapters, the frameworks will be used to guide reflexive DSS development in the IWRAM project, which is developing a DSS to assist integrated environmental management in the highlands of Northern Thailand. In Chapter 5, the frameworks will be used in conjunction with reviews of the highland environmental history and the political culture of highland decision-making to foreshadow potential biases which may arise if DSS is introduced into the highland decision-making environment. Chapter 6 presents a narrative of how I used the proposed frameworks to catalyse researchers participating in the IWRAM project to interrogate potential biases and negotiate convergent framings of decision support.

Table 4-1 Framework for anticipating bias in DSS

A: Background to the application context
A1. Why was this development of DSS initiated?
A2. What decision problem(s) is the DSS intended to support?
A3. How might this problem change over time?
A4. Who are the stakeholders to this problem?
A5. Characterise the existing policymaking processes relevant to this problem, including a power analysis of the stakeholders to the problem.
A6. Who are the intended users (direct and indirect) of the DSS?
A7. What benefits are these users expected to derive from use of the technology?
A8. In the light of (A2,A6 and A7), what are the information requirements of the technology?
A9. Will the DSS be applied in conjunction with any other policy mechanisms?
What are the criteria for success of the DSS?
B: Embedded bias
B1. Describe the people who are intended to be involved in development of the DSS. Why will they be involved? When will they be involved? How will they be involved?
B2. Describe those stakeholders who are not intended to be involved in the development of the DSS. Why won't they be involved?
B3. Will different stakeholders views be considered during the construction of the DSS or incorporated in any form? If so, how?
B4. How will the decision problem be framed? Who will frame the problem? What alternate ways are there of construing this problem?
B5. How rapidly and easily will the DSS respond to changes in the decision problem or application context over time?
B6. Describe the hardware, software, models and data sets which are anticipated to be incorporated in the DSS. Why will they be incorporated? How will they be integrated?
B7. Have any hardware, software, models or data set options previously under consideration been rejected? If so, why?
B8. What uncertainties and assumptions (including constraints and boundary conditions) are associated with the underlying processes or system components?
B9. How is it intended that the output of the DSS presented to the user?
B10. How is it intended that uncertainties and assumptions related to the output, underlying processes or system components be communicated to users?
C: Biased access
C1. What is the intended geographical structure of the DSS?
C2. Compare the location of potential users relative to the DSS.
C3. What are the likely up-front and running costs of the DSS? Who will bear these costs?
C4. Compare the costs of the DSS to the financial resources available to potential users of the system.
C5. What degree of conventional or computer literacy is likely to be required to use the system?
C6. What degree of conventional or computer literacy is likely to be required to analyse potential biases in the system output?
C7. Compare the likely literacy requirements of the technology to the literacy levels of potential users of the system.
C8. How will the DSS articulate with existing or intended policymaking processes and institutions?
C9. In the light of (A5) and (C2,4,7,8), is it likely that use of the DSS will improve the access of any individual or group to policymaking relative to the existing situation?
C10. In the light of (A5) and (C2,4,7,8), is there a risk that use of the DSS will worsen the access of any individual or group to policymaking relative to the existing situation?

Locating the decision-making environment: The highlands of northern Thailand

Some of the highland villagers argue that government policies aimed at reserving and protecting the highland forests have denied them of wood traditionally used for housing, cooking and heating.

5. Locating the decision-making environment: The highlands of northern Thailand

This chapter is intended to embed analysis of the IWRAM case study, presented in Chapters 6 and 7, within the geographic, cultural and political decision-making environment of the highlands of northern Thailand. In particular, it aims to foreshadow and offer insights into tensions between alternate framings of decision support which emerge during the IWRAM case study.

The first three sections explore the highland decision-making environment. The chapter opens with a brief geographic profile of the northern highlands. To illuminate the politics of highland development theory and practice, Section 5.2 traces an interpretive narrative of the highland environmental history. Viewing historical narratives as reconstructions, Section 5.2 does not pretend to be a singular, definitive explanation of the environmental history. Instead, it reflects my selection, organisation and weaving of historical fragments which I have deemed influential in shaping the ecological, political and sociocultural environment of the highlands. Key themes explored include interactions between lowland and highland stakeholders, and the influence and role of Western science, politics and development philosophy on the highland decision-making environment. To inform key relationships and events represented in the historical narrative, Section 5.3 discusses characteristics of the political culture of highland environmental decision-making.

The final three sections are intended to locate DSS and the IWRAM project within the highland decision-making environment. Section 5.5 discusses the state of highland environmental decision support. Drawing on the IWRAM project proposal, Section 5.6 describes the research approach of the IWRAM project, and explores how this project is confronting challenges of integration, co-ordination and participation. Drawing on the highland environmental history and politics as well as the taxonomy of bias, the chapter concludes by exploring potential biases in relation to the IWRAM DSS.

5.1 Geographic profile

Comprised of the seventeen administrative provinces (*changwat*) which lie to the north of the Central Plain, Northern Thailand covers an area of 169 644 km^2 (RFD 1994). In contrast to the plains of the Lower North, the landscape of the Upper North is one of hills and mountains, interspersed with narrow valleys. Within the rugged mountain ranges are many peaks in excess of 1500 m, including Doi Inthanon, which at 2576 m is the highest mountain in Thailand (Tem et al. 1978:24). The headwaters of several major rivers are located in these ranges, including the Ping, Yom, Wang and Nan rivers, the four main tributaries of the Chao Phraya river which irrigates Thailand's Central Plain.

The Northern highlands experience a monsoonal, tropical savanna climate, with distinct wet and dry seasons. The southwest monsoon is active from May to October, bringing moisture from the Indian Ocean, and blanketing the highlands in dense rain cloud (Anat et al. 1987:15). The dry season runs from October to May. From October to February, the northeast monsoon carries dry, cold air from China, causing highland temperatures to cool to less than 10° C . From March to May, a hot, dry climate prevails, raising temperatures to around 30° C.

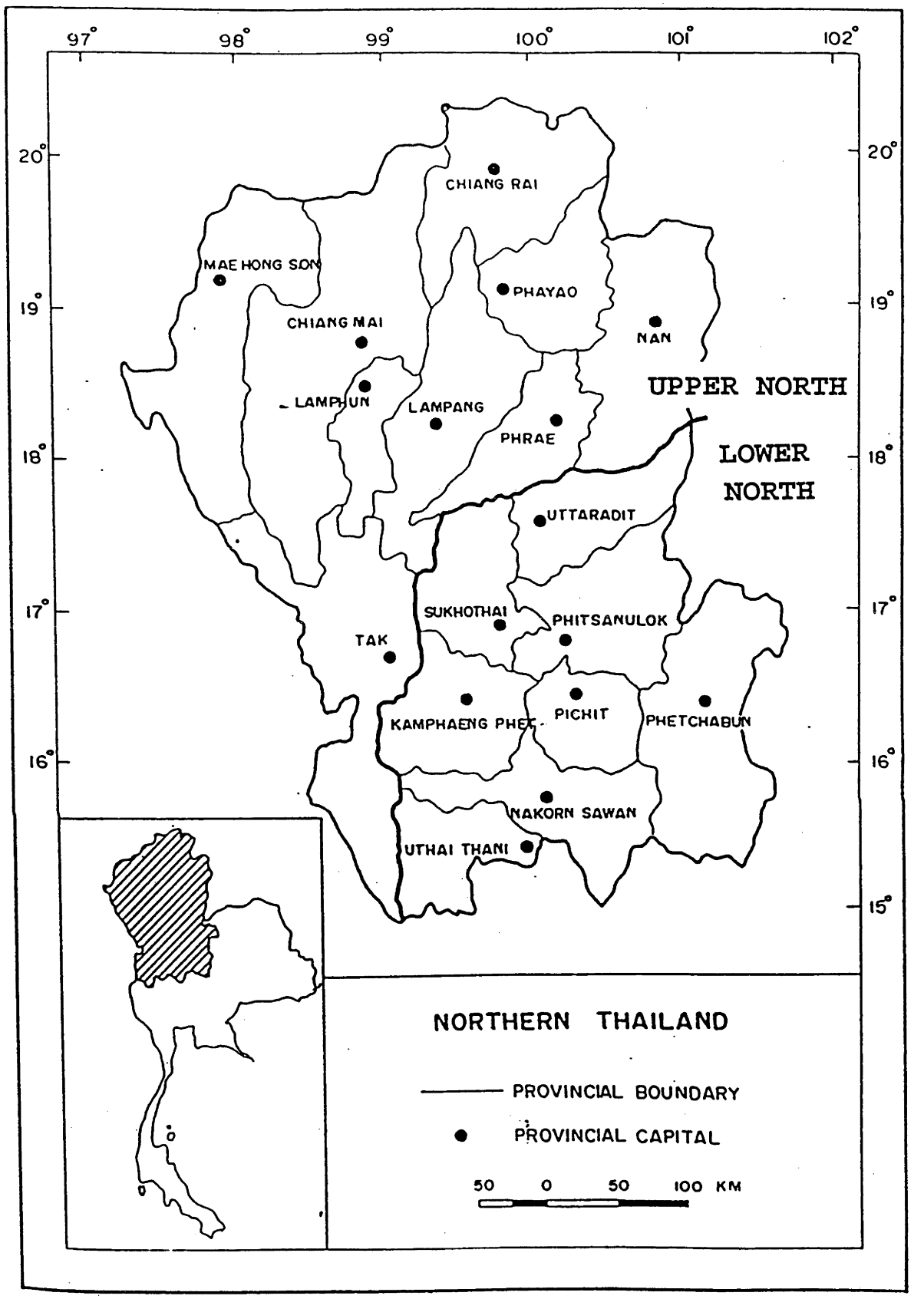

Figure 5-1 Northern Thailand (Source: Kanok and Benjavan 1994:4)

The Upper North is classified into three agroecological zones: the highlands; the intermediate uplands; and the lowland valleys. The lowlands are densely populated by *Tai* speakers, mainly the Northern Thai or *Tai Yuan* (Anan 1996:204). The upland and highland zones, which are often collectively referred to as 'the highlands'[10], have traditionally been sparsely populated by a number of non-*Tai* 'hill tribe' communities. While hill tribes represent only about 6% of the Northern region's population of 11 million, many of the mountainous provinces in the Upper North have sizeable hill tribe populations. For example, about 19% of the total population of Chiang Mai, 60% of the population of Mae Hong Son, 25% of the population of Tak, and 16% of the population of Nan identify as hill tribes (Kanok and Benjavan 1994:6). It should be emphasised that hill tribe population figures are approximates. Accurate figures are difficult to obtain from census data as only around 61.2% of hill people have Thai citizenship (Kampe 1992:159).

Prior to World War II, the population density in the Northern highlands was contained by remoteness and diseases such as malaria and smallpox (Kunstadter and Kunstadter 1992:21). Since the 1950s, more effective control of diseases and extension of infrastructure have enabled a dramatic increase in stakeholders, with increasing numbers of lowland Thais moving into the uplands. Due to the increase in population density, the Northern highlands, which were originally covered in dense forest, have been subjected to extensive clearing, primarily for agriculture, although resorts and other tourist ventures are becoming increasingly common. Now, only around half of the Northern highlands is covered in evergreen, mixed deciduous and dry dipterocarp forest. Smaller remnants of tropical coniferous forest, teak and other plantations are scattered across the landscape. However, at 44 %, the Northern region still has the most extensive forest cover in Thailand, compared with a national average of 26% (RFD 1994).

5.2 Highland environmental history: Politics and pressures[11]

5.2.1 Early settlement history

Although the early settlement history of the highlands of Northern Thailand is sketchy, around the 8th century, people of the Karen and Lua hill tribes, considered indigenous to Northern Thailand and adjoining areas of Burma and Laos, are thought to have settled in the forest covered highlands (Bhruksari 1989). The Karen and Lua formed permanent settlements in the foothills and middle elevations, where they hunted and gathered wild forest products, and practiced rotational shifting cultivation (Kundstater 1978, Pasuk and Baker 1995:50). Under rotational shifting cultivation, a village would clear a plot of secondary forest on their communal land for the village households to cultivate swidden fields (Kunstadter and Kunstadter 1992:23). After the annual crop had been harvested, the land would be left fallow for around ten years to enable secondary forest regrowth and ecological rejuvenation, before being recultivated. The traditional Karen

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[10] In this thesis, the term 'Northern highlands' is used to refer to the mountainous region of the Upper North comprising the upland and highland agroecological zones. Where the term 'highland' is used to refer to the agroecological zone, this is explicitly stated.

[11] Readers interested in alternate accounts should see Reynolds (1992) exploration of historians' (re)constructions of the 'plot' of Thai history, and Thongchai's (1988) treatise on the influence of cartography in recreations of Thai territorial history.

and Lua land management regime has been credited as having a strong conservation ethic. For example, vegetation on steep slopes, along rivers, and at the headwaters of streams were preserved to prevent erosion (Kunstadter and Kunstadter 1992:25). Forests in which spirits were believed to dwell were also preserved, and provided seed stores and wildlife shelters (Kunstadter and Kunstadter 1992:25).

During the thirteenth century, *Tai* warriors migrated from China and seized power in strategic places throughout South-East Asia[12] (Wyatt 1984:38). Numerous small *Tai* states were established in the lowlands of Northern Thailand in which a prince (*jao*) would rule over a cluster of peasant villages which were primarily engaged in wet-rice cultivation (Keyes 1989:28). Within this pre-capitalist *sakdina* society, peasants were compelled to provide labour to the ruling aristocracy, who monopolised administrative, political and economic power (Hewison 1989:36). During this period, the ancient *Tai Yuan* kingdom of Lanna, which encompasses most of Northern Thailand as delineated today, was founded, and construction of its capital city, Chiang Mai, began in 1296 (Wyatt 1984:48). Historical accounts suggest that Lanna was a highly contested region from the fourteenth to the mid-eighteenth centuries, with the kingdom constantly engaged in internal and external warfare and control oscillating between various *Tai* and Burmese regimes (Wyatt 1984:74). In 1776, *Tai* armies of the Kingdom of Ayutthaya recaptured Chiang Mai, and by the late eighteenth century, the Bangkok-centred Siam state (the antecedent of the modern Thai state) had consolidated a loyalty-protection relationship with the semi-autonomous Lanna principalities (Keyes 1989:27, Wyatt 1984:142,155). It should be noted that at this time, territorial boundaries were perceived as irrelevant since a political sphere "could be mapped only by power relationships, not by territorial integrity" (Thongchai 1994:79).

During the Lanna period, the highland people lived a fairly autonomous existence. However, they were not isolated from interaction with the lowland *Tai* courts. For example, lowland Thai rulers negotiated feudal tribute and trade agreements with individual highland communities to acquire highland forest products, such as beeswax, which were a vital component of foreign trade (Marlowe 1969:54, Jonsson 1996:176-7). Other interaction arose through warfare, slave raids by the *Tai* on highland communities, and the employment of highland people by the *Tai* for menial labour. These latter forms of interaction appear to reflect a pattern of domination by the *Tai* over hill peoples which had been established prior to and during their migration from China to Thailand (Wyatt 1984:8,41). Despite their limited economic and political interaction, the highland and lowland communities maintained a distinct separation, largely because of the geographic remoteness of the highland settlements. Jonsson (1996:178-9) suggests that the separation was also partially maintained by opposing ritualistic constructions of space: "lowlanders lived in areas uplanders associated with witchcraft; uplanders inhabited what lowlanders viewed as the domain of wild animals and spirits".

During the eighteenth and nineteenth centuries, small numbers of Akha, Lahu, Lisu, Hmong and Mien tribes also migrated into the highlands, where they settled in the unoccupied higher elevations above the Karen and Lua settlements (Bhruksari 1989 cited in Waranoot 1995:279). Savina (1930:173-176) suggests that lowland hostility drove the newcomers into the mountains. However, Geddes (1976:30-31) argues that

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[12] For a detailed history of the Thai migration from China into the Indo-China peninsula see Rong 1986.

their settlement at higher elevations reflected a traditional attachment to mountain living. Kunstadter (1978) suggests that poor agricultural conditions at these higher elevations dictated a system of pioneer shifting agriculture for survival. Under pioneer shifting cultivation, a household would clear and burn forest and other vegetation on a small parcel of land to grow crops. When the productivity of the land declined, due to soil nutrient depletion or weed infestation, or if 'bad spirits', sickness or conflict became associated with the land, the household would relocate to a new site. In contrast to the communal system of the permanent swiddeners, cultivation and relocation decisions were managed by individual households, and allegiances to the village were tenuous (Kunstadter 1992:29). As migratory groups, the pioneer swiddeners did not tend to emphasise conservation or sustainable management. None-the-less, given the low population densities, the abandoned land would gradually recover, and after around 15-20 years, would become covered in secondary, closed-canopy forest (Fox et al. 1995:329). Thus, with low population pressures, an equilibrium was maintained between loss and recovery of closed-canopy forest cover, and sustainability of the ecological system was not compromised.

5.2.2 Colonisation of the Northern resources

During the late eighteenth century, Chinese migration increased markedly into the area now delineated as Thailand, and by the mid-nineteenth century, Chinese immigrants controlled much of the internal Siamese trade (Keyes 1989:48). By 1850, a small teak industry, dominated by Chinese foresters, had been established in Northern Thailand. The foresters were required to obtain leases from the relatively autonomous local *jao* who granted concessions to forest use in exchange for fees and gifts (Vandergeest 1996:161). Fees were divided by the ruling *jao* into three portions: one for himself; one for his official 'noble' collector; and one for the owner of the forest (Phen 1981 (1903):306). The foresters sold the teak locally as a material for house building, fencing, boat building and fortifications (Slade 1981(1896)).

During the 1850s, Northern Thailand began to receive attention from the British, who were keen to demarcate a clear boundary between Burma and Northern Thailand (Thongchai 1994:68). Without the knowledge of Bangkok, the British negotiated a boundary treaty with Chiang Mai (Thongchai 1994:68). As fixed boundaries were perceived as irrelevant to political claims, Chiang Mai was amenable to signing a treaty so long as the British accepted the task of surveying and marking boundaries (Thongchai 1994:69).

In the 1870s, the British, followed soon after by the French and Danish, shifted their teak exploitation activities from the South Burmese forests into Northern Thailand (Sharlardchai 1989:32). Not only were the Burmese forests near exhaustion, but the activities of the Western forestry firms had been increasingly disrupted by the Burmese civil war (Pasuk and Baker 1995:100). Of all the teak forests in Northern Thailand, those in Chiang Mai, Lampang, Lamphun, Nan, Phrae, Chiang Saen and Chiang Rai were most highly prized because of the superior quality and abundance of teak wood (Phen 1981(1903)). In 1875, a British Consul Officer concluded that "The teak worked out into the Bangkok river does not exceed 1,000 or 2,000 logs a year, though very much more might be obtained if the forests were worked" (Edwardes 1981(1875)). The foreign interests "tuned to the needs of the external commercial economy and equipped with a more efficient technology... set a course to exploit [the Northern forests']

virtually untapped timber and mineral resources more thoroughly than subsistence farmers could ever have imagined possible" (McKinnon 1983:333).

Records from this time refer to the Northern mountains as being inhabited by lawless Karens and Shans who were liable to rob passing traders, and who had claimed and worked the mountain forests for many years (Edwardes 1981(1875)). These 'bandits' were portrayed by Bangkok as a threat to the security of the Northern Thai cities, demanding an attack by well-disciplined Thai troops (Government of Thailand 1981(1902)). Other records describe the Northern *jao* as having discredited the Siamese reputation by slaughtering Shan and Karen men and forcing their wives and children into slavery where "they suffered as greatly as beasts" (Rama V 1981(1885)). With foreign interests in the North expanding, Bangkok became concerned that the Northern *jao* would embarrass the central government, or worse, create conflict with the British, who had demonstrated their military might during the Chinese opium wars. Hence, during the 1870s, Bangkok moved to secure the integration of Lanna into the Siam state through centralising revenue collection and other administrative functions (Wyatt 1984:194). However, despite the incorporation of the Northern periphery within the Thai administrative domain, wild animals, robbers and malaria continued to discourage settlement of ethnic Thai in the highlands, which remained sparsely populated by hill tribes (Pasuk and Baker 1995:50).

By the late 1880s, Chiang Mai had become a major exporter of teak, particularly to British ship builders (Vandergeest 1996:161). From an average of 5 000 m^3 during the period 1873-76, the annual export of teak rose to around 62 000 m^3 during 1895-99, and reached a peak of 122 000 m^3 during 1905-1909 (Ingram 1971:96). Although a few small forests were worked by their Thai owner or local officials, the British overwhelmingly dominated the Thai teak industry (Slade 1981(1896)). By the early 1890s, the British teak firms had become concerned about the viability of the Northern forests. Ingram (1971:110) comments that "wanton and indiscriminate cutting of timber... became so extreme in the late nineteenth century that the teak companies themselves urged government regulation to stop it because no single company could compete successfully if it alone took the proper measures of conservation". The concerns of the teak industry should be considered in the context of increasing conflict between the British companies and the *jao*, who often attempted to improve revenue either by leasing the same area to several companies or by imposing extra charges (Van der Meer 1981:21).

Rather than submitting to the *jao*'s demands, the British chose to undermine the *jao*'s claims to power by encouraging the extension of Bangkok's sovereignty to the northern frontier (Vandergeest and Peluso 1995:396). To prompt swift action, the British threatened to assume control of the northern periphery if the Thai government did not act swiftly and decisively to exert greater administrative control over the Northern forests and curtail the influence of the local *jao* (Vandergeest and Peluso 1995:396). In response to the British pressure, the Ministry of the Interior sent provincial governors and district officers to start assuming control from the Northern princes. The government officials organised the Northern villages into permanent, registered villages with recognised village heads (Thongchai 1994:120). At the time of the administrative reforms, the Thai state also rewrote the forest concession contracts, including requiring recipients of concessions "to plant 4 baby trees for every teak tree felled" (Phen 1981 (1903)).

By the early 1900s, western-style cartography had become accepted by the Thai state as indispensable technology in negotiations over contested spaces: "modern mapping was the only geographical language the West would hear and only a modern map could make an argument" (Thongchai 1994:121). Thus, the traditional conception of political claims as based on spheres of influence had been displaced by a concern for territorial proof. Along with surveying boundaries, the state had also developed an interest in mapping the internal geography of Thailand to enable clear identification of their legitimate space (Thongchai 1994:119, 131).

To ensure administrative control over unoccupied lands, the Thai state established the Royal Forestry Department (RFD) in 1896, under the directorship of a British forestry expert (Vandergeest 1996:161). British foresters continued to occupy the position of Director-General until 1924, when the first Thai was appointed (Sharlardchai 1989:43). Many of the early Thai directors of the RFD had been educated in the forestry schools in British colonies of India and Burma. Thus, as Sharlardchai (1989:43) remarks, the RFD "emerged from the philosophy and practice of British logging companies during the peak of exploitation of teak forests in Burma and Thailand". Based on the Indian and Burmese forest management and policy models, in 1899, the RFD claimed jurisdiction over all land within the boundaries of Siam that was neither occupied nor claimed by any person or agency (Vandergeest 1996:161, Santasombat 1995:21). It is significant to note that since the hill tribes were not citizens of the Thai state, their occupation was not recognised. Hence, the centrally constructed responsibilities of the RFD served to delegitimise established hill tribe settlements. It is also significant to note that land officially classified as 'forest' was not required to be covered in forest. Thus, the RFD was able to claim jurisdiction over around 75% of Thailand, and emerged as one of the most powerful state agencies (Vandergeest and Peluso 1995:408).

The RFD also assumed responsibility for the collection and distribution of royalties from forest leases (Phen 1981 (1903)). By the early 1900s, the granting of forest leases to foreigners had been recognised as having adversely impacted the local people. In the Mae Ping forest, Phen (1981(1903)) notes that "When common people wanted to construct teak houses, they could not buy any teak wood. If they bought the teak wood from foreigners (sic), the price they had to pay was very high... This was troublesome for poor people". The freedoms of the highland people were further eroded by the passage in 1938 of the *Protection and Reservation of Forests Act.* This Act empowered the RFD to demarcate 'protected' and 'reserve' forests, and was intended to stop peasants from clearing and cultivating forest land, and thereby taking it out of the jurisdiction of the RFD (Vandergeest 1996:163-4). Note that people who had been living, often for many years, in forests which were declared as reserved were transformed into illegal violators through the bureaucratic delineation. The Act also authorised state holdings of commercial forests which could be leased to foreign or Thai logging companies (Santasombat 1995:21).

Another significant environmental development during the early twentieth century was the expansion of opium cultivation in the Northern highlands. The expansion appears to have been initiated in part by the Chinese Imperial anti-opium decree (1906) which marked the beginning of a concerted effort by Chinese authorities to eliminate opium cultivation by Chinese farmers (Crooker 1986:69). These opium suppression measures encouraged more intensive opium production in the highland regions which overlap the borders of Burma, Laos and Northern Thailand, forming the so-called 'Golden Triangle'

(Allen 1986:70). During this period, Chinese migration into Thailand also intensified, leading to an expansion in domestic demand. To control the opium trade, the Thai government taxed opium sales and established a state monopoly to which highlanders could legitimately sell opium (Geddes 1976:208, Jonsson 1996:180). By the early 1920s, around 20% of Thailand's national revenue was due to opium (Scott 1969:136).

During the 1930s, lowland Northern Thai introduced irrigated agriculture to highlanders, and wet-rice cultivation began to spread throughout the upland ecological zone (Kunstadter 1992:31).

5.2.3 Post-war development, conflict and growth

Prior to WWI, the term *burana*, meaning 'restoration' or '(re)construction', tended to frame state and monarchical reforms aimed at modernisation (Demaine 1986:95)[13]. Post-WWI, discursive referents to notions of 'development' by the Thai state shifted to an interpretation of development as 'progress'. As a result of the 1932 coup, which overthrew the absolute monarchy in favour of a constitutional system of government, the hierarchical *sakdina* principles of economic and political organisation were formally replaced by the logic of capitalism (Hewison 1989:59). As Thailand began to recover from the post-WWI depression, Prime Minister Phibun, who held office from 1938-1944 and 1947-1957, reinforced industrial development and capital investment as the means to transform and strengthen the Thai economy (Hewison 1989:67). Phibun also introduced the concept of *wattana* which promoted national advancement through cosmetic deference to the social customs and dress style of Western civilisation (Demaine 1986:95, Wyatt 1984:255).

During this period, the government initiated limited development efforts in the highlands. The Border Patrol Police (BPP), which was established in the early 1950s to ensure a security presence and gather intelligence in remote frontiers, was the first government agency to have formal development-oriented contact with the hill tribe people of the Northern highlands (Tapp 1989:32). In 1956, the Government also established a Committee for the Welfare of People in Remote Areas to provide food and clothing to hill people (Suwan 1969:12).

During Phibun's era, in the face of mounting pressure from foreign governments to better contain Thailand's contribution to global narcotics production, opium cultivation was restricted to the highlands of Northern Thailand (Anderson 1993:116). The Thai state was reluctant to ban opium cultivation outright because of its contribution to the national economy. In 1953, a Thai government official admitted to an international convention on narcotics control that the Thai state "could not afford to give up the revenue from the opium business" (Walker 1991:214).

A new era of interventionist developmentalism was ushered in during Sarit's prime ministership (1958-63). Firmly couched in western modernisation theory, Sarit's development model (*pattana*) equated national development with economic growth, and transformed state treatment of the highlands from relative neglect and indifference to active political and economic intervention through substantive development policies

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[13] For example, King Chulalongkorn's (1868-1910) initiatives to refashion a modern Bangkok, create a modern army and centralised bureaucracy, construct transport infrastructure, and introduce standardised Western-style education are located within this framework.

(Brown 1994:167, Prudhisan 1992:51). Sarit argued that technocratic expertise was the key to develop Thailand into a modern, efficient and powerful state (Girling 1981:82). He installed Western-educated Thais to craft policies aimed at increasing economic and material prosperity through developing infrastructure, encouraging foreign investment and promoting integration into western markets (Tatsanee 1989:12, Muller 1996:33). Agricultural policies emphasised productivity gains through diversification and modernised practices, while forest management policies focussed on state allocation of land for economic development. The law limiting landholding to 50 rai was also revoked, creating opportunities for real estate investment and speculation in the highlands for those holding Thai identification papers (Turton 1978:111). Several laws were also enacted ostensibly aimed at conservation: the *Wild Animals Reservation and Protection Act* 1960 established wildlife sanctuaries and hunting free areas, and the *National Parks Act* 1961 established a system of national parks (Vandergeest 1996:166). These latter laws extended the territorialisation initiated in the 1800s, and resulted in more highland villages being demarcated as illegal settlements. The laws legally eliminated any requirement for consultation with local villagers, and reinforced a further shift in land management power from the villagers to the Royal Forestry Department (Vandergeest and Peluso 1995:409).

Sarit's development approach also emphasised social harmony and moral integrity. For example, in an effort to restore cleanliness and orderliness to Thai society, an *Anti-opium Act* was passed which banned the cultivation, sale and consumption of opium (Wyatt 1984:280). Jonsson (1996:181) suggests that the prohibition of opium strengthened state power by undermining the bargaining power of the highland cultivators. Despite a rhetorical concern for social well-being, social dimensions of development were largely relegated to the downstream benefits which proponents assumed would 'trickle-down' from growth in the national GDP (Demaine 1986:94). The exception was the emphasis placed on construction of purportedly 'social' infrastructure, particularly the expansion of electrification and road construction into rural Thailand. This policy was based in part on commissioned advice from the World Bank, and reflected the prevailing western development philosophy (Demaine 1986:96). The extension of infrastructure also played into national security interests, as it provided a means of integrating the culturally insulated rural periphery into the control of the Bangkok-centred state (Prudhisan 1992:52). Beyond allowing more efficient provision of government services, rural feeder roads which linked villages to state highways, facilitated the distribution of economic benefits to poor highlanders, thereby confronting the perceived underlying cause of insurgency (Chairat 1988:207). The road network also enabled more rapid deployment of government troops in the event of an uprising (Chairat 1988:207). The explicit national security context of highland development policy reinforced a visible and influential role for the Thai army in highland development practice (Gohlert 1991:37).

The extension of infrastructure in the highlands was accompanied by targeted efforts to apply Sarit's economic and social development policies to particular highland villages. In this context, a National Hill Tribes Welfare Committee was formed in 1959, and initiated a number of projects during the 1960s, administered by the Department of Public Welfare, which were aimed at improving the development and welfare of the highland people (Tapp 1989:31).

It is significant to note that despite his heavy reliance on western expertise to craft his policies, Sarit explicitly cast his path to development within traditional Thai political culture. He argued that a benevolent authoritarian system controlled by a strong executive was better suited to traditional Thai paternalism than alien Western democratic norms (Likhit 1992:160). Consequently, development priorities were identified by the patrimonial leader and his expert bureaucracy, rather than defined by specific needs articulated by the targeted rural population (Jacobs 1971). Sarit's model of development thus discouraged popular participation in decision-making, so that there were "no inherent expectations of participation by the people - either on the part of the authorities and even less on the part of the individual citizen" (Gohlert 1991:87).

Following Sarit's death, his deputy Kittikachorn continued to promote policies aimed at realising Sarit's vision of a modernised and wealthy Thai state. For example, the *National Forest Reserves Act* (1964) provided for "further expansion of state holdings of forest lands, which were then leased out to private firms for commercial exploitation" (Santasombat 1995:21). The Act also declared swidden shifting cultivation environmentally and economically harmful, and prohibited 'unlawful' uses of forest land and forest products without formal authorisation by the RFD (Rerkasem and Rerkasem 1994:10, Santasombat 1995:21). As a result of this policy, from the mid-1960s, highland villagers cutting wood for their traditional livelihoods, including household construction, were increasingly arrested on charges of illegal logging (Waranoot 1995).

During Kittikachorn's term, the state also continued Sarit's policy of assimilating the highland villages into the sphere of the Thai polity. In 1964, the Border Patrol Police initiated a project to train highland people in first-aid, agriculture, sanitation, 'correct' politics, and as voluntary border security guards (Tapp 1989:32). In 1965, the *Nationality Act* was passed, which included a National Integration Policy granting hill people the opportunity to become a Thai citizen, a right that had previously been denied (Rerkasem and Rerkasem 1994:3). To facilitate integration of the hill tribe people into Thai culture and administrative order, and promote acceptance of the state development policies, the Thai government enlisted the assistance of Buddhist orders. Monks were trained in rural and community development, and sent to villages "to instill a sense of loyalty to the nation, government, religion and King... to convey the government's policies... [and] to inform the government of the people's needs and attitudes" (Somboon 1993:68). In particular, they were encouraged to convert hill tribe people from animism to Buddhism, and to educate them as to Thai language and customs, and their duties and responsibilities to the Thai state. The monks also distributed medicine and other items as gifts of the Thai state (Somboon 1993:71). By integrating the hill people into the fold of both the Thai state and Buddhism, security-conscious Bangkok hoped that a sense of loyalty would be fostered which would dissuade terrorist activities.

During the mid-1960s, a groundswell of antigovernment insurgency throughout Thailand lead to fears in both the Thai and U.S. governments that communism was making inroads in Thailand. In the North, the main combatants in the rebellion were Hmong villagers, whom the Thai state suspected were being supported by the Chinese communist party (Wyatt 1984:289). To combat the communist threat, the anti-communist Chinese Irregular Forces (CIF) were assisted by the Thai and the U.S. to protect the highland border areas. The CIF argued that participation in the opium trade

was necessary to finance their arms purchases (Crooker 1986:88). Thus, in contravention of the official anti-opium decree, during the mid-1960s, the Thai and U.S. governments accepted opium trade as a lesser evil in return for national security, and covertly sanctioned the CIF to act as a border patrol and to collect duty on non-CIF opium caravans entering Thailand (Crooker 1986:90). The Thai state also supported military action against some of the highland villages suspected of involvement in the insurgency. Heavy artillery, napalm, air strikes and ground troops were used to destroy villages (Girling 1981:264). By 1968, around 40% of the highland people of Nan province had become homeless (Tapp 1989:36). Many of the displaced people were forced to abandon their migratory existence and resettle in new areas determined by the government (Tapp 1989:36, Girling 1981:264).

During the late 1960s, the US and British, facing mounting internal drug-related politics, began to exert increasing pressure on the Thai state to curb narcotics trafficking, and to shift away from state tolerance of opium cultivation. The Bangkok-based government also began to recognise that, rather than dissuading communist insurgency, the heavy-handed tactics of the CIF army had driven many dispossessed villagers to join with the communist forces (Crooker 1986:93). Consequently, the Thai state began to take measures to more actively enforce the 1959 anti-opium decree, including closing the opium refineries in the North, and to enact development and security policies less likely to alienate the highlanders (Crooker 1986:94). In 1967, the central government announced that its main policy objectives for the highlands were to: end opium cultivation through alternate cash crop substitution; and prevent deforestation and land degradation, attributed to pioneer shifting cultivation, by encouraging migratory tribes to adopt permanent agriculture (Suwan 1969:13). Permanent settlement areas were demarcated which also served as experimental research stations for extension of agricultural innovations (Suwan 1969:13). The provision of government services such as education and heath were offered as inducements for participation in the settlement programme (Suwan 1969:13). The Government also reintensified efforts to instill a sense of belonging and loyalty to the Thai nation in the highlanders, including maintaining political and economic support for a visible and active role for Buddhist monks in hill tribe villages, and organising visits by hill tribe leaders to witness progress and development in the lowlands (Suwan 1969:14).

Sarit's development approach led to an economic boom in Thailand in terms of high growth rates and a reduction in the poverty rate. However, the benefits of the accelerated economic growth were concentrated spatially and socioeconomically. The result was widening income disparity between industrial and rural sectors, major inter-regional disparities, illustrated in Table 6.1, and persistent poverty among inhabitants of the rural periphery. State development policies during the 1970s began to recognise and respond to some of these inequities, espousing more widespread provision of health and education. However, in the North, as national security interests remained paramount, development attention was targeted at those villages which were suspected of or had demonstrated involvement in opium cultivation or insurgency (Demaine 1986:99). Villages which did not meet these criteria were less likely to receive the development assistance, and sometimes lost their land, without compensation, to the government for road construction or establishment of permanent settlements (Demaine 1986:98). As these latter villages tended to be poorer, subsistence rotating shifting cultivators, in

contrast to the richer, cash cropping opium growers, the development policies of the 1970s often exacerbated economic disparities amongst the highland people.

	1960	1970	1980	1983
Whole country	2 106	3 849	14 743	18 770
Bangkok	5 630	11 234	41 300	51 441
Northern region	1 496	2 699	9 866	12 441

Adapted from Brown (1994:166)

Table 5-1 Spatial disparities in per capita income in Thailand (baht/yr)

By the 1970s, the opening of the Northern frontier combined with increasing capacity to control disease had enabled a marked increase in the number of stakeholders competing for highland resources. A key factor was Thailand's rapid population growth from 18 million in 1947 to 34 million in 1970 (Wyatt 1984:292). Urban and industrial expansion, stemming from this population growth and underpinned by the modernisation development ethos, had contributed to increasing rural indebtedness and land shortages in the lowlands. As the extension of infrastructure in the highlands improved accessibility, increasing numbers of lowland people began to migrate into the highlands, seeking potential high returns from highland swidden cash crops (Tapp 1989:36). Through natural increases in birth rates as well as migration, the hill tribe population in the Northern highlands had also risen significantly; from approximately 100 000 in 1948 to around 284 500 in 1973 (Kanok and Benjavan 1994). In 1975, the communist takeover of Laos stimulated the influx of many Hmong and Mien families who had fought against the communists into refugee camps in the Northern highlands. Around 125 000 Hmong entered these camps between 1975 and 1981 and by the late 1970s, about 7300 Mien were living in Thai refugee camps (Allen 1986:30)[14]. The increasing population density in the highlands, combined with economic policies which supported the expansion of export-oriented agricultural areas, motivated mass deforestation in the highlands (Mingsarn et al. 1995:29). The deforestation, and the population increase, contributed to landlessness and land shortages in the highlands. By 1981, 13% of farmers in the Upper North were landless, 31% were near-landless with farms less than 5 rai, and a further 28% owned farms of less than 10 rai (Anat et al. 1987:39).

By the early 1980s, it had become apparent that, contrary to Sarit's modernisation assumptions, wealth had not trickled down to the two thirds of Thais who inhabited rural areas. Critical views of the conventional development ethos had increasingly been voiced within Thai academic discourse since the 1960s. The centralised process, authoritarian practice and concentrated outcomes of the conventional development ethos were critiqued not only on the basis of their practical failures, but also through appeals to western notions of democracy and freedom (Demaine 1986:99). During the early 1980s, the decline of the communists in Thailand created room within the development arena for a raft of Non-Government Organisations (NGOs) which drew on these

[14] Notably this massive migration forced the Thai government to reassess its presumptive treatment of hill peoples as communists (Lewis and Lewis 1984).

critiques to promote 'alternative development' philosophies and methodologies for the rural periphery (Hirsch 1996:6). Generally constituted of educated, middle-class urban Thais, the NGOs tended to portray themselves as facilitators of participatory development for local community empowerment. Although the NGO approaches varied considerably, they tended to differentiate themselves from the conventional state model by virtue of their greater emphasis on the self-reliance and the development of local capacities, particularly through education and the facilitation of local agricultural cooperatives. They also tended to emphasise local specificities and contexts including technology, knowledge, spiritual traditions, and traditional forms of organisation.

5.2.4 Highland development projects

During the 1980s, the alternative development philosophies increasingly penetrated state development rhetoric, with references to participatory, collaborative, and decentralised development practice commonplace. The Fifth Plan, prepared by Thailand's central planning agency, the National Economic and Social Development Board (NESDB), and implemented from 1981-1986, both reflected and reinforced a state shift away from a purely economic and efficiency oriented development. Decentralisation of economic activities, culturally appropriate technology and community-driven development were emphasised (Demaine 1986:103). A succession of highland development projects, often jointly sponsored by the Thai state and a foreign aid agency, were subsequently implemented which purported to effect the revisioned mode of development. These included the Thai/UNFDA[15] Crop Replacement and Community Development Project, the Thai-German Highland Development Project, Doi Ya Pamon Highland Development Project, the USAID-supported Mae Chaem Watershed project, the Sam Mun Highland Development Project and the Thai-Australia Highland Agriculture Social Development Project. It should be noted that, in part due to a controversy surrounding anthropological activities in Thailand[16], neither anthropologists nor sociologists tended to be involved in these development projects (McKinnon 1983:11). Instead, the development efforts tended to be the domain of Westerners or Western-trained Thais with technical expertise in agricultural, economic and forestry practice. Consequently, the approach promoted by the highland projects emphasised more effective integration of the target villages into a cash crop market economy through transfer of western technical innovations and expertise. The highland development projects also promoted the establishment of highland schools, ostensibly to improve literacy of the highland people, but also more covertly as a mechanism to promote the state's integrative and assimilative policies. For example, Tapp (1989:37-38) discusses how the establishment of schools by development projects in Hmong villages have acted as conduits for government information dissemination, and have indoctrinated a sense of loyalty to the Thai state into Hmong children through rote repetition of nationalistic phrases presented as literacy aids.

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[15] United Nations Food and Drug Administration

[16] This refers to the charges made by some American anthropologists that field anthropologists based at the Tribal Research Centre in Chiang Mai were assisting the Thai and US military in clandestine information gathering exercises. (see McKinnon 1983).

Box 5-1 Highland development projects: Non-coordination and non-participation revealed

The Mae Chaem Watershed project (1980 - 1989) was an integrated project aimed at encouraging self-reliance among the poor people living in Mae Chaem, in raising their income and improving their access to social services (MCWP 1989a,b). At the completion of the project, all personnel and officers involved were interviewed as to their ideas and opinions of the project, so that the experience of the MCW could be used to help development of other watersheds in the North. In terms of integration, interviewees felt that cooperation was not real, with each participating organisation continuing to work independently. In the eyes of the villagers, the different organisations were not interconnected and were each performing their own service. Other problems identified were the reticence of the farmers to use the irrigation systems that had been constructed and the low rates of success of the new agricultural practices introduced for conservation, which was attributed to a lack of understanding on the part of the villagers of how to utilise and maintain them. It was suggested that future projects should place a greater emphasis on community-based participatory methods and on greater cooperation between government and non-government agencies.

The Thai-Australia Highland Development Project (TAHDP) (1980-1987, 1988 - 1993) was initially focussed on developing agricultural technology to improve the production of cash crops in the uplands. Strategies included crop rotations, pest control, seed multiplication and extension. In 1985, the original project collapsed when various departments failed to take over project management as had earlier been negotiated. In 1989 the TAHDP joined with an International Board for Soils Research and Management project into upland sloping land agriculture for sustainability. Research emphasis during Phase 2 shifted to land management in small watersheds, focussing on strategies for soil conservation. Most work involved developing techniques on experimental demonstration plots. Adoption of these techniques outside the demonstration areas has remained minimal, largely because many farmers have not perceived any social or economic advantage in long term soil conservation strategies.

Most projects theoretically encouraged a participatory and co-ordinated approach. However, with the exception of the Sam Mun development project, post-project evaluation has failed to support the rhetoric. While efforts were made to co-ordinate project administration between the various central ministries or departments involved, activities in the field were seldom co-ordinated. Furthermore, in practice, programmes tended to be highly centralised, and driven by the external experts rather than the local 'target population'. These experts tended to have limited prior acquaintance with their target areas, and to spend only short periods in the highland villages during the development project (Hinton 1992:112, Tapp 1989:40). Through presenting the project to a village meeting, project rhetoric maintained that "full consultation with the people has been established" (Keen 1983:305). However, the projects were generally designed to address problems, defined by the external observers, that villagers were assumed to experience (Demaine 1986:109). The projects' objectives tended to reflect a measure of quality of life, usually increased income and consumer goods, that the villagers were assumed to desire. As Hirsch (1990:14) notes, participation in these projects tended to translate into "the doing rather than the initiating or the deciding". Since the targeted communities seldom acquired independent decision-making authority, critics suggest that few if any of the projects achieved their stated objective of self-reliance (Kampe 1992:162). Others have suggested that self-reliance was undermined by the

unsustainability of inputs, such as subsidised seeds, pesticides and fertilisers and marketing, which were supplied by projects[17].

The projects were charged by critics with neglecting the values and interests of the target communities in lieu of technological and institutional considerations (Yos 1989). Tapp (1989:40) notes that villagers complained of the "cultural chauvinism" of project officials who they felt "did nothing to help them". Others claimed that the solutions promoted by the external experts were based on an oversimplified analysis which neglected the complexity of the local ecology and political culture, "did not care for the people and was more concerned at the literal application of the planned schedule that they were in solving the problem" (Hinton 1992:112). In this vein, McKinnon (1983:327) decries the application of generic land use zone templates and zonal development, which presuppose transmigration of communities, as paternalistic and unrealistic. Drawing on the experience of the Thai-German project, Puginier (1997) notes that the labour demands of the permanent agriculture cash crops were often much higher than previous cultivation methods. The inappropriateness of development project assumptions manifested in villagers' reluctance to participate in implementation of these strategies. As Keen (1983:305) argues, "the people who struggle by various means for a livelihood in the hills of north Thailand have had foisted upon them a series of narrowly defined (but administratively convenient) land use programmes with which they could not, and did not, identify". Supporting this claim, Hirsch (1990:15) notes that villagers often expressed feelings of being pestered and forced into participating in development projects. It is thus unsurprising that when projects finished, and the external agents were no longer providing financial and other inducements to participate, cultivation practices often reverted to pre-project strategies.

Since, like previous state development initiatives, most of the highland development projects were motivated by narcotics control through opium crop substitution, they tended to perpetuate inequities between different tribal groups. The Hmong, the traditional opium growers, tended to profit from development attention. The Karen, the traditional conservationists who account for around one half of the total hill tribe population, tended to be neglected by development projects (Renard 1988 cited in Jonsson 1998:18). In 1987, there were only 0.09 projects per Karen village compared with 1.25 per Hmong village (Ministry of Education 1987). Exacerbating the disparities, with the market experience that opium cultivation afforded, the Hmong tended to adjust successfully to market-oriented commercial cash-crop production. In contrast, as traditional subsistence producers with limited market experience, and increasingly impoverished, the Karen tended to be susceptible to the vagaries of the market, such as sudden falls in commodity prices (Anan 1987). Furthermore, many Karen lost land through state development programmes which used the promise of secure title to fertile upland land to persuade the opium growers or insurgents to settle permanently. As Jonsson (1998:18) notes, "The world-views of international developers and the Thai Government, and their ranking of the groups whose livelihood they affect, set up who gets aid in an environment that is increasingly parcelled out by outsiders".

With their emphasis on opium eradication, the highland development projects tended to focus on alternative cash crops which would yield sufficient income to be an attractive

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[17] Personal interview with Oliver Puginier, 17 November 1997.

substitution, without consideration of their environmental impacts (Anan 1996:211). The widespread cultivation of some of the promoted cash crops, particularly cabbages, and the intensive use of promoted pesticides and fertilisers, proved environmentally destructive, leading to a dramatic decline in both soil fertility and species diversity (Kampe 1992:162). Some of the grasses promoted as soil and water conservation measures infested the land and were difficult to eradicate (Puginier 1997). Marginalisation of the traditional conservationists further exacerbated the declining state of the environment (Anan 1996:209).

*5.2.5 **Unsustainability: pressures heighten***

Through the 1980s, the numbers of highland stakeholders continued to increase, intensifying pressures on the highland resources. Due to high birth rates, the hill tribe population had risen to 749 353 by 1995[18]. Meanwhile, by 1990, the Thai population had grown to 56 million, prompting increasing numbers of lowland Thai farmers to move into the Northern periphery (RFD 1994:108). The construction of roads combined with liberalisation of land ownership laws had enhanced the value of land sited near roads, leading to a boom in private sector interest and investment in plantations, highland resorts, golf courses, restaurants and other tourism ventures. Although the proportion of land which had been converted to private sector tourist ventures by the late 1980s was not expansive, Dhira and Panayotou (1990:2) note that it affected "some of the best agricultural land both in terms of its productivity and its proximity to markets". In the wake of the increased investment in highland real estate, only around 32% of hill people now own their own land (Kampe 1992:159). While some highland villagers have portrayed the land speculators as a welcome means of escaping poverty, others claim that the land speculators, in collusion with corrupt village headmen, stole the villagers' common forests upon which they depended for grazing land and as a source of firewood, farm materials and food (Sanitsuda 1990:131-142). Anan (1996:205) argues that the Karen, vulnerable in confrontations over control of the uplands, were particularly marginalised in the drive by lowland people to take control of and capitalise from the upland resources.

Competition for the highland resources led to a dramatic decline in dense forest cover, as stakeholders sought to expand into new territory. From 1960 to 1990, 14.4 million acres of forest were cleared (Mingsarn 1993:14). By the early 1990s, only around 45% of the North remained under forest cover (RFD 1994:3). As the extent of deforestation became more widely recognised, increasing royal, religious, state, intellectual and public concern over environmental deterioration in the highlands placed pressure on the state for more effective highland environmental conservation and management. In response to public concern (especially from the large Bangkok political constituency and the lowland farmers downstream) that deforestation was exacerbating flooding and landslides in the lower reaches of the Chao Phraya river, the Thai government introduced strict policies which banned logging concessions, restricted forest access and increased protected areas. By 1990, 257 forest reserves had been declared in the Northern region, amounting to 113 904 km^2 (RFD 1994:11).

The demographic pressures combined with the more restrictive conservation and reservation policies led to an increasing scarcity of arable land for the traditional

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[18] Directory of Highland Communities and Population, National Security Council 1993.

highland farmers. As the feasibility of agricultural expansion diminished, development agencies introduced Green revolution technologies to the highland communities as a means of increasing income and providing continued food security in the face of diminishing resources. Through extension, agricultural diversification and intensification became widespread throughout the highlands. In most areas, cropping frequency increased, resulting in shortened fallow periods. Traditional specialisation in products based on locally-available resources was largely replaced by market-driven crop diversification, with intercropping of maize with legumes and of temperate fruit trees with vegetables and flowers becoming common (Kanok et al. 1994). Accompanying the agricultural intensification was a greater reliance on fertilisers and pesticides, and increased water use as low-cost gravity-fed sprinkler irrigation systems became widespread (Kanok et al. 1994). Typical highland household activities diversified to include: subsistence crop production from swidden farming; cash crop production from permanent agriculture; livestock raising; gathering of wild vegetation, firewood and minor forest products as food supplements, fuel and income; and production of handicrafts for the burgeoning tourist industry. It should be noted that although opium cultivation had decreased, many highland villages continued to grow small plots of opium poppies either for personal consumption or cash sale (Anderson 1993:121).

For those highland villagers which adopted the commercial approach promoted by the development agencies, increased integration into a market economy through lucrative cash cropping led to increased incomes and greater contact with lowland people. This in turn contributed to altered perceptions of living standards, and greater demand for and consumption of lowland merchandise. It also fostered a sense of relative deprivation amongst those villagers unable to acquire pick-up trucks, refrigerators, transistor radios and other 'modern' consumer goods (Chairat 1988:210). Thus, accelerated integration into the market economy provided both participating and non-participating villagers with additional impetus for income improvement and further intensification.

By raising land productivity, intensification of agriculture can reduce land requirement, thereby relieving land pressures and providing a greater window of opportunity for forest regeneration (Kanok et al. 1994:128). However, as the land to population ratio falls, intensification may bring a host of adverse environmental and social effects. In the Northern highlands, shorter fallow periods, in an effort to speed up the rotation cycle, and cultivation of fragile, steeply sloping marginal land as arable land has become scarce, have both exacerbated soil erosion. Road construction has also led to severe erosion (Kunstadter and Kunstadter 1992:36). In 1990, the Department of Land Development estimated that 39 million rai of upland agricultural land was affected by severe to very severe soil erosion (Dhira and Panayotou 1990:15). On many highland farms, soil erosion has reduced the chemical and physical fertility of the soil, leading to declining crop yields. To maintain productivity of the unsustainable system, highland farmers have responded by applying increasing amounts of pesticide and fertilizer, affecting the toxicity levels of both soils and produce. Adverse health impacts following the use or application of pesticides have been noted by many highland farmers (Kanok et al. 1994:xxv).

Due to the interconnectedness of watersheds, the impacts of highland degradation have not been contained within the highlands. Increased soil erosion has been blamed for accelerated reservoir sedimentation and increased surface runoff downstream, while

pesticide and fertilisers which have washed off highland farms have been blamed for higher toxicity and nutrient loadings in lowland streams. The causal assumptions implicated in this assignation of blame have been queried (Enters 1992). None-the-less, the practices of highland communities have been widely blamed for environmental problems in the lowlands, and increased pressure has been placed on the state to relocate villages out of the highlands, and to educate them about more sustainable practices. As Vandergeest and Peluso (1995:413) have observed, ecological threats have enabled continued framing of the highlands as a national security issue, with environmental desecration now replacing subversive terrorism. Those advocating relocation often emphasise that the hill people are illegal encroachers on state property. The relocation conflicts illustrate that historical tensions persist between the lowland Thai and the highland communities, who continue to be treated as primitive and destructive outsiders in need of integration into the civilised Thai state.

There are a number of pragmatic disincentives for state relocations of highland villages. Firstly, several government officials and academics have observed that where villages have been forcibly relocated, the villagers have experienced significant psychological ramifications. Secondly, given the chronic land scarcity, there are few viable areas to which villages may be relocated. During 1993-94, a state-commissioned study investigated the potential relocation of populations living in conservation forests in the Mae Taeng, the Chern and the Klong Yan watersheds (Ruangdej and Jerapan 1994). In most cases, the study concluded that no suitable areas outside the conservation forests could be identified that could accommodate relocated populations, so population management and environmental rehabilitation measures would have to be implemented within the conservation areas. Beyond the pragmatic disincentives, forced relocation introduces fundamental moral questions. Highland farmers, supported by several academic commentators, claim that continued deforestation is largely attributable to illegal logging, facilitated by bureaucratic ineptitude and corruption. They thus argue that prime responsibility for forest depletion should be assigned to forestry officials, logging companies and developers, rather than scapegoating the highlanders. Highland farmers also maintain that where they have been guilty of deforestation, through personal encroachment or participation as labour in illegal logging, this has often arisen because they have not had sufficient employment opportunities to feed their families or service their debts (Pratuang 1996:120). They further note that stricter environmental policies have served to deprive the highland farmers of resources traditionally used for income supplement and home consumption, such as wood for fuel and housing (Ammar et al. 1991). The highland farmers' perspective has been accorded increasing articulation in the media due to the mobilisation of spontaneous and NGO-facilitated farmer protest groups in response to controversial environmental policies. Because of the practical and moral complexity, state agencies are often reluctant to effect forced removals, leading to inconsistency between policy and agency practice.

Since the mid-1980s, the Thai media has reported an escalating number of local conflicts between lowland and highland communities over the downstream impacts of highland resource use, and the continued movement of lowland Thais into the hills (Sanitsuda 1990). However, it should be noted that environmental conflict may provide only a superficial explanation for highland politics. As Waranoot (1995:283-285) revealed in a study of a highly publicised conflict between Hmong highlanders and ethnic Thai lowlanders over the forest and water resources of the Mae Soi watershed,

allegedly 'environmental' conflicts may have complex social, economic and cultural dimensions. While the lowland farmers involved in the Mae Soi conflict attributed the genesis of the conflict to the Hmongs' deforestation practices and subsequent contamination of the Mae Soi river, most highlanders felt that the conflict had started when a cattle thief (a lowlander) was killed in a Hmong village. Ethnic differences, lowland resentment over the economic success of the Hmongs' cash crops, and the activities of an outspoken and celebrated conservationist who advocated relocation of the hill tribes, have also been cited as possible sources of the conflict.

5.2.6 Confronting sustainability?

By the early 1990s, foreign partners had begun to withdraw support for highland development projects owing to Thailand's apparent economic success. Their departure coincided with increasing realisation within government agencies of the failures of the development projects, including their contribution to degradation of the social and ecological highland environment. State development policy responded to these problems by heeding appeals from NGOs for more sustainable highland environmental management, including more effective participation. The Sixth National Economic and Social Development Plan (1987 - 1991) introduced the concept of "ecodevelopment" which linked environmental development with economic and social development. The Seventh Plan (1992-1996) sought to establish a base for long-term sustainable growth by balancing economic growth, quality of life concerns and social justice. The current Eighth Plan (1997-2001) ("a long term vision of a desirable society") is designed on the premise that development which ignores environmental and human development will "eventually affect the sustainability of long term development", where sustainability is defined as tridimensional, relating to the economy, the environment and human resources. Echoing the Eighth Plan, a spokesperson from the Ministry of Science, Technology and the Environment frames the task of confronting sustainable development as "planning and implementing economic-cum-environmental developing projects, where the investment pays good dividends in both financial earnings and in environmental protection" (Kasem 1996:336). Thus, although social and environmental concerns have become more visible, national development continues to be firmly linked to economic profit and growth.

Allusions to participatory responses to ensure sustainable and consensual resolution to environmental conflicts increasingly feature in the policies of state agencies involved in highland decision-making. For example, in 1992, the RFD was restructured to place an emphasis on extension, rather than just forest protection and control, and to support greater decentralisation of activities to provincial and district levels (Pragtong 1993:118). Following the restructuring, the RFD purports to have "started working more closely with local communities currently living in conservation forests" (Pragtong 1993:118). One of the perceived advantages of participatory co-management of forests is that it enables more effective protection from encroachment since manpower and resource limitations place constraints on the RFD's ability to patrol vast areas (Quinn 1994:22). The move towards more participatory natural resource management was reinforced in October 1997, when King Bhumibol Adulyadej signed a new Thai constitution, the first to be formulated through widespread public participation, into law. The constitution requires the state to promote public participation in decision-making (Section 76), and "in the preservation, maintenance and balanced exploitation of natural

resources and biological diversity and in the promotion, maintenance and protection of the quality of the environment in accordance with the persistent development principle as well as the control and elimination of pollution affecting public health, sanitary conditions, welfare and quality of life" (Section 79)[19]. The constitution also affirms the duty of citizens to conserve natural resources and the environment (Section 69), and the right of persons, including traditional communities, to participate in both the preservation and exploitation of natural resources and biological diversity, and the protection, promotion and preservation of the quality of the environment (Sections 46,56).

Despite rhetorical claims to empower the poor through locally-specific, participatory development, both NGO and state-sponsored sustainable development projects have been charged with failing in practice to deliver sustained community empowerment. Critics have suggested that the sustainable development approaches are merely conventional strategies couched in politically fashionable terms. Like the conventional projects, sustainable development projects have tended to act as catalytic agents in transforming subsistence agrarian production to commercial market-driven agriculture through financial support of agricultural intensification. One NGO worker justified this approach through reference to the wider decision-making environment: "We... are struggling for the betterment in the state's framework and mechanism" (Quinn 1994:17). Like the conventional models, the sustainable development projects also tend to reflect an externally-driven agenda and leadership regime which neglects critical dimensions of the local decision-making culture. Consequently, as with the conventional models, community participation has often failed to materialise (Gohlert 1991:57). Opart (1992) discusses farmers reluctance to participate in a grass-roots agroforestry project initiated by the RFD. The RFD attempted to engage highland farmers in establishing eucalyptus plantations in their agricultural areas, as a compromise between the RFD's reforestation imperative and continued settlement by the farmers (Opart 1992:153). The RFD offered that the farmers could remain in the reforestation areas and plant their crops between the rows of trees (Opart 1992:153). However, the farmers were unwilling to co-operate, and further, tried to sabotage the plantations, because they perceived the eucalypt plantations as a mechanism to drive them off their land: "After two or three years, the fast-growing trees establish a canopy which shades out crops such as cassava, beans and maize,... and take up so much water that the crops cannot compete and cultivation is no longer worthwhile" (Opart 1992:153). This example illustrates that participatory approaches may not necessarily be either beneficial to the participant or benign, but instead may be employed to obscure motivations for control.

In a detailed exposition of participatory development in rural Thai villages, Hirsch (1990:15) highlights the role of local power/control structures in shaping who benefits from participation: "...divisions internal to the village involve a divergence of interests among villagers and a partial convergence of interests between village elites and state developers". In a similar vein, Gohlert (1991:57) argues that community participation in Thai rural development projects "generally translates into various degrees of co-operation with local elites who facilitate the work of development agencies". Alternately, Quinn (1994:7) describes how a Thai NGO development project acted to

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[19] Constitution of Thailand, http://www.krisdika.go.th/law/text/lawpub/e11102540/text.htm

raise to elite status a non-elite villager mediating between local interests and project personnel. In each of the preceding cases, development projects emerge as cultural devices in the reinforcement or reproduction of local power structures.

Despite policy references to collaborative and participatory ideology, scientistic beliefs in the mutual exclusivity of human settlement and effective environmental conservation remain visible within the practice of many state agencies. Anan (1996:213) argues that "state agencies still subscribe to the idea that for forest conservation, people and forest cannot co-exist, especially those ethnic groups who are considered 'enemies of the forest". This attitude is evidenced by Huai Hong Khray, a state showcase model of integrated watershed management, which was formed by flooding a Northern forest and relocating the resident villages out of the watershed. A variety of government departments conduct sustainable management experiments and demonstrations in the watershed, employing many of the former residents as wage labour. Environmental rationale, within a conventional scientific paradigm, continues to provide a rhetorical device to reinforce state authority in prescribing highland resource use and thereby validate state control of the highlands.

The environment has not only been employed by the state as a means to acquire legitimacy of control over contested highland resources. Increasingly, the highland communities are reinforcing their capacity to act as guardians of the forest through exemplar community forests and sustainable agriculture (Anan 1996:217). Thomas (1995:17) notes that the adoption of recommended conservation practices by upland communities has in some cases been part of a bargaining strategy for tenurial security: "Researchers found that the primary reason for the [contour vegetative] strips was because [untenured] farmers perceived they would improve their chances for gaining tenure, or at least decrease risk of being evicted by government officials". Highlanders, supported by NGOs, are also increasingly employing G.I.S. mapping technology to enhance their negotiative authority over contested claims to resources. One NGO worker commented that: "Mapping has been a powerful tool in villages in Northern Thailand... Some villagers have actually been successful in getting the RFD to change their position - to modify areas and redraw boundaries. The villagers together with NGOs and people's organisations had to fight back with information - for good or bad, they needed the hard data"[20].

5.2.7 Elements of the decision-making environment

The contemporary decision-making environment of the Northern highlands of Thailand has been shaped by complex webs of interaction and intervention. Relationships between present-day stakeholders, their framings of 'the problem' and their approaches to solutions are embedded within historical narratives which highlight recurrent politics of control. Prior to the eighteenth century, the Northern highlands were portrayed by Thai as a wild and dangerous place of marginal interest to lowlanders. Colonial interest in highland forests, formation of the Thai nation-state, the creation and reinforcement of the RFD, and state security imperatives have contributed to construction of the highlands as a valuable resource, in need of rational and paternalistic control and protection. Contemporary attempts to reinforce state control of the future of the Northern highlands from the highland communities echo eighteenth-century Bangkok's

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[20] Personal interview with Karan Aquino, 18 November 1997

consolidation of control over the North from the Northern *jao* (Jonsson 1996:186). In place of the threat of upsetting foreign powers, ecological security is increasingly invoked to validate strategies of control. Environmental management has emerged as a discourse by which stakeholders may acquire legitimacy in claims over contested spaces and resources. Battles over space and material resources in turn implicate contested constructions of human-nature relationships. From eighteenth century cartography to modern-day G.I.S., western-derived sciences and technologies have repeatedly been appropriated, internalised and employed by highland stakeholders as discursive tools in these battles. The complex, multifaceted politics engaged in the history of highland environment reveal as naive the assumption that highland environmental problems are physical, politically benign problems amenable to rational optimisation, or that DSS may provide an objective, politically neutral tool.

Despite profligate development efforts, the conservation gains that successful realisation of policy rhetoric would have entailed, have simply not materialised (Hinton 1992:116). Beyond failing to live up to their promises, development efforts have often served to exacerbate the declining health of the ecological, political and sociocultural environment of the highlands. In part, this has been due to the uncritical transposition of Western-derived models of environmental management, from the demarcation of forests commencing in the 1800s through the foreign development projects of the 1980s to the sustainability initiatives of the 1990s (cf Redclift and Woodgate 1994). This history challenges the assumption that environmental problems may be resolved through recourse to generalised methodology, raising questions about potential absences or distortions in knowledge if a generic western-constructed DSS is introduced.

5.3 Political culture of environmental decision-making

To illuminate aspects of the preceding historical narrative, and to inform the exploration of potential biases associated with the IWRAM DSS, presented in Section 5.6, this section briefly outlines elements of traditional Thai political culture which continue to underpin networks and relationships between highland stakeholders and to influence stakeholder process.

5.3.1 Hierarchy and subordination

Authoritarianism, elitism and hierarchical 'patron-clientage' relationships have been widely observed as salient features of modern Thai society (Attwater 1996, Gohlert 1991, Terwiel 1983). The parallel existence of these elements with the Thai conception and experience of democracy reflects the enduring influence of the traditional Thai value system. The latter has been shaped by the patriarchal rule of the ancient Sukothai kingdom (1238-1378) and the adoption of Theravada Buddhism during the Ayutthaya period (1350-1767). During the Sukothai period, the incumbent ruler assumed the role of father of the populace which obliged him "to render the people assistance but... not (to) allow them self-government or to exert control over those in the power pyramid" (Thinapan and Likhit 1989:167). The Sukothai period also introduced a formula for leadership which balanced *phra dej*, whereby "the patron can extract loyalty and obedience as a consequence of his clients' fear", and *phra khun*, whereby "the patron entices his clients, ingratiating himself with them by using bribes and favours to generate a sense of obligation" (Wright 1991:95). According to the modern patronage construct, as articulated by Keyes (1989:136), "individuals higher up in the hierarchy

seek validation of their power from among those below them, and in return those lower down expect tangible benefits from their superiors".

Theravada Buddhism, which sanctions hierarchy through the law of kamma, was formally adopted during the absolute monarchy of the Ayutthaya period. Theravada Buddhism affirmed the political authority and legitimacy of the King to ensure social order (Somboon 1993:43). Buddhism also provided a rhetorical framework for civilised society which reinforced a distinction between uncivilised non-Buddhist highland people and the civilised Thai lowlanders (Jonsson 1996:172). Widespread public devotion to Theravada Buddhism is suggested to be responsible in part for continued adherence to traditional notions of differential rights to power relative to status. Thinapan and Likhit (1989:179) assert that "Most Thais are prone to exercise absolute power if they are in a position to do so. They are also prone to defer, obey and submit to those in power". Thus, subordinates must demonstrate unconditional deference and obedience to their superiors. This requires them to refrain from questioning or challenging the opinions of superiors, and to desist from displays of personal initiative which might challenge the status quo and incur their superiors' displeasure (Gohlert 1991:87). This 'culture of subordination' has been claimed to suppress criticism of the social order (Hirsch 1990:189); thereby inhibiting freedom of speech and formal consensual decision-making while encouraging the monopolisation of power by the ruling elite and top-down decision-making. When conflict arises between stakeholders, the matter is often resolved through informal negotiations (Thinapan and Likhit 1989:190). A formal meeting may then be arranged to ceremoniously rationalise and legitimise the preordained outcome.

Superior-subordinate relationships are evident within Thai family structures, institutions and the educational system. Two manifestations of the superior-subordinate maxim which have a pervasive influence over sociopolitical interaction are the monarchy-masses and the bureaucrat-masses relationships. These relationships are remnants from the two-class structure of traditional Thai society, which separated the nobility from the peasantry. Constitutionally, the monarchy is above politics. Although previous monarchies have been regarded less favourably as symbols of political manipulation, the present monarchy of King Bhumibol is popularly revered. Slights against the monarchy are not tolerated either legally or socially. In the case of environmental management, this precludes critiques of royally-sponsored environmental programs or public debate of environmental objectives and strategies articulated by the King. The status of the monarchy is such that, in order to gain favour, government institutions involved in natural resource decision-making have been observed to reconsider their policies and programs in the light of suggestions made within a royal speech.

Government officials, literally 'royal servants' (Hirsch 1990:19), are similarly accorded prestige and status. When, in the late 1800s, King Chulalongkorn created a modern Thai bureaucracy based on the European model of functional ministries, bureaucratic positions were given to the ruling nobility, thereby maintaining the traditional two-class feudal structure (Hirsch 1990:19). Contemporary class distinctions between the urban-based bureaucrats and the predominantly rural masses continue to reflect a belief that politics is "an affair of the ruling elite rather than a fundamental right of citizens" (Thinapan and Likhit 1989:176). Associated are stereotypes of bureaucrats as educated and modern, and villagers as passive, ignorant, unsophisticated and apathetic (Demaine 1986:110). Concomitant with this perspective, participation is often treated by state

officials as the increased co-optation of local communities in the implementation of stipulated state objectives (Thawithong 1984: 2-3 cited in Hirsch 1990:190). In this way, strategies aimed at increasing participation of the village polity may act as a vehicle to reinforce state power at the community level and thereby to undermine active local decision-making. Notably, a number of bureaucrats, many of whom occupy positions of seniority, denounce these generalisations, and express appreciation of indigenous knowledge and management[21].

Perpetuation of the traditional patron-clientage system of social relationships has also been linked to widespread corruption in Thai administration and politics. As Pasuk and Sangsit (1994:4) note, " The patron-client relationship connects the officials to the people and is the most organised system to allocate social gains and interests... Such a system institutionalises exchanges of money and power which may be classified as corruption". Consequently, corruption has been tolerated according to the traditional norms of the patronage system, even though it is illegal according to Thai law. In terms of the highland environment, corruption has been charged with responsibility for continued deforestation. For example, Quinn (1994:22) notes allegations that corrupt forestry officials, politicians and entrepreneurs had colluded to claim title on conservation forest.

In recent years, a number of authors have indicated signs of the erosion of the traditional hierarchical class structure and the elitism and corruption with which it has been associated. Several authors have signalled the emergence of social stratification based on wealth (Hirsch 1990:20). Since the student uprising of 1973, there have been growing demands for curbs to bureaucratic power (Chai-Anan 1990). Since 1997, Thailand's economic crisis has led to more widespread realisation that corruption may lead to repercussions on the global financial market with far-reaching economic implications for Thai society. This has accelerated appeals for political reform, culminating in the adoption of a new constitution aimed at dispelling corruption and decentralising decision-making. However, several political commentators have suggested that resistance to change is substantial. Thinapan and Likhit (1989:169) assert that the powerful "cling to the idea of elitism". Chai-Anan (1990:15) argues that "bureaucratic reforms in Thailand are more oriented toward incremental structural adjustments rather than decentralisation and citizen participation. Furthermore, when the issue of decentralisation becomes central to more effective implementation, there is a tendency to utilise this policy to strengthen and expand the power of the central government". These perspectives suggest that adoption of a new constitution may not necessarily translate into practical reform, unless institutions, policies, programmes, and the discursive conditions enabling stakeholder interaction are similarly reconstructed.

5.3.2 Fragmentation and non-coordination

The Thai state has been described as an ensemble of institutions with "scope for multiple directions of state action and thus also for differences of emphasis, divergence of goals; non-co-ordination and even incompatibilities among state development programmes" (Hirsch 1990:18). This perspective has validity in the context of environmental decision-making in the Northern Highlands, which features a multitude

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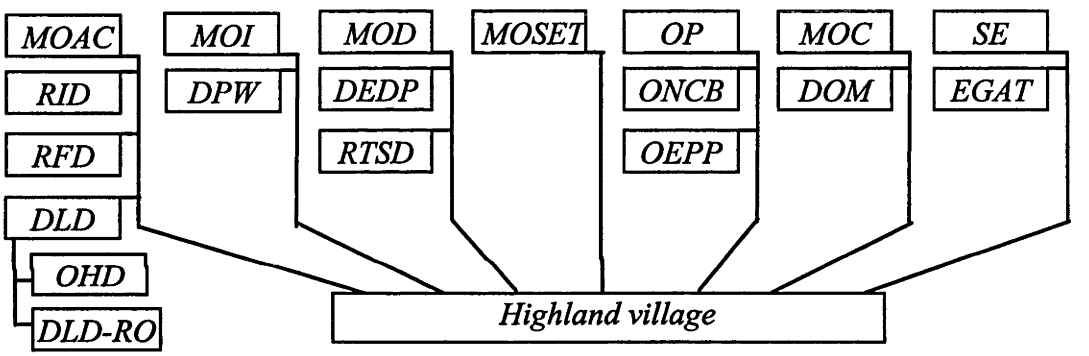
[21] Personal conversation with Mr Boonyarak Suebsiri, former Director-general of the Department of Land Development, June 1996.

of overlapping and competing claims on the natural resources across geographic and institutional scales. Figure 5.2 illustrates the number and diversity of state agencies with an interest in the use, development or management of the highland natural resources.

The various state agencies involved in highland environmental decision-making tend to act independently and autonomously. Even in the case of an officially multiagency project, integrated, co-operative action is rare. Against this institutional background, many government officials remain confused about the concepts of integrated management and interdependent sub-projects, despite their incorporation within state policy rhetoric for many years (Demaine 1986:109). Centralised Bangkok-based departmental committees may co-ordinate in the planning of broad project objectives. However, each agency then develops separate field level work plans which meet these objectives, and assign personnel to accomplish specific tasks related to the work plans. The activities or progress of one agency are seldom communicated to other agencies working at the project site. This non-coordination was highlighted as a key problem in a post-project evaluation of the Mae Chaem Watershed Project, an "integrated rural highland development project" involving the Royal Forestry Department, Department of



MOI: Ministry of Interior	*DPW: Department of Public Welfare*
MOAC: Ministry of Agriculture and Cooperatives	*RID: Royal Irrigation Department* *RFD: Royal Forestry Department* *DLD: Department of Land Development* *OHD: Office of Highland Development* *DLD-RO: DLD Regional Offices 6,7,8*
MOD: Ministry of Defence	*DEDP: Department of Energy Development and Production* *RTSD: Royal Thai Survey Department*
MOSET: Ministry of Science, Environment and Technology	
OP: Office of Prime Minister	*ONCB: Office of Narcotics Control Board* *OEPP: Office of Environmental Policy and Planning*
MOC: Ministry of Communications	*DOM: Department of Meteorology*
SE: State Enterprises	*EGAT: Electricity Generating Authority of Thailand*

Figure 5-2 Selected state agencies with an interest in highland natural resource management

Land Development, Department of Public Welfare among other government agencies (MCWP 1989a, 1989b). As a result, administration was duplicated, and villagers perceived that the different organisations were performing their own service, rather than an interconnected program. The tradition of overlapping and duplication of functions, unclear jurisdiction, and limited communication and co-ordination has been noted across institutional scales, down even to the level of individual divisions of a department (Chai-Anan 1990:17,29, Demaine 1986).

One reason for duplication of responsibilities and lack of co-ordination between agencies lies with the Thai parliamentary system, in which different ministries and even different components of a ministerial portfolio are presided over by the different coalition partners in government. Another reason is the bureaucratic position classification system, whereby "a divisional chief has to create more functions and ask for more personnel in their division in order to claim that the quantity and quality of work are large enough for the elevation of their [position classification]. This behaviour leads to overlapping and duplication of functions and also centralization" (Chai-Anan 1990:27).

Departmental parochialism arises in part because projects are perceived as mechanisms to expand the role and resource base of the department. Since collaboration would amount to power-sharing and the dispersal of influence, co-operation is not encouraged (Van der Meer 1981:129). This parochialism acts as a significant constraint on the practice of integrated environmental management, as environmental data is fragmented amongst the agencies, and guarded fiercely. Departmental loyalty is reinforced by a system of promotion and rewards based on patronage (Chai-Anan 1990:26). Where coordination does occur between government agencies, the interaction between institutions is frequently governed by personal loyalties, notably through kinship and common school or university backgrounds.

Because of the lack of co-ordination between government agencies, local communities often receive conflicting directives from the different agencies. For example, the Department of Public Welfare and the RFD are often in conflict over the settlement and provision of services to highland villages. Since the ban on commercial logging concessions in 1988, the role of the RFD has focussed on environmental preservation (Thomas 1995:3), and the RFD has been an active advocate of relocating villages out of the highlands to enable forest regeneration. In contrast, the Department of Public welfare, which is concerned with the welfare and security of all people living within the Thai state, has promoted and invested in the establishment of permanent infrastructure, including schools, water pumps, electricity and medical facilities; legitimising settlement of villages earmarked by the RFD for relocation.

5.4 DSS for the Northern Highlands

In recent years, increasing use of information technology in Thai government institutions involved in environmental management has led to growing state agency interest in computer-based modelling systems and other information technology to assist environmental planning and policymaking. The value of these systems is seen to be derived from their capability to process and manipulate large amounts of information, and hence to contribute to "good and efficient services" and "effectiveness of governance" (NPITD 1996). According to Thailand's National Policy on Information

Technology Development, "information technology can play a pivotal role... to support many of the government's policies for ... conservation of the nation's natural resources and environment" (NPITD 1996). Thai NGOs are also increasingly promoting the development of integrated GIS-based environmental databases and computer systems capable of analysing ecological interactions. As with the state rationale, in their advocation of these systems, NGOs frequently cite the importance of more accurate, up-to-date and integrated information to achieve a transition to more sustainable development (Anat et al. 1987:304).

Despite political support for more widespread computerisation, DSS has not yet been widely applied in Thailand. In Northern Thailand, a limited number of applications of DSS have stemmed from research at the Multiple Cropping Centre (MCC) in Chiang Mai University. The MCC was established in 1969, under sponsorship by the American philanthropic Ford Foundation, to develop and extend multiple cropping systems which would be more profitable for northern farmers (Ireson 1976:3). Initial research focussed on agroeconomic problems such as optimum application of agricultural chemicals and the economic return from different crop varieties (Ireson 1976:3). By the late 1970s, sociological researchers had been engaged by the MCC to explore socio-economic components of agricultural decision making, such as the goals motivating farmers' crop choices. As computer technology developed, research turned to development and application of DSS which integrated biophysical, agroeconomic and decision making mathematical programming models. For example, Pramote (1994) evaluated risk decision making models as a predictor of rice farmers' behaviour, and concluded that risk models performed better than the conventional profit maximisation models, and should be employed to inform government formulation of agricultural programs.

Despite the research described above, interviews with a range of stakeholders suggested that there is general confusion and ignorance amongst academics, government officials, NGO workers and other stakeholders as to what DSS entails. The IWRAM project seems to represent the first attempt to develop a DSS which is intended for broad use by highland stakeholders. However, the interviews also revealed that officials from a variety of state agencies were enthusiastic about greater integration of GIS with models to assist their decision-making. Interviews with NGO workers highlighted a widespread belief that a commitment to the empowerment of villagers was increasingly requiring villagers to become literate in the use of the computer technology which the state employed. All of the highland NGOs I spoke with were involved in projects using GIS to map village territory. One NGO was involved in preliminary negotiations with researchers at Chiang Mai University to develop a GIS and modelling system, effectively a DSS, in collaboration with their regional organisations. Thus, while DSS in Northern Thailand is currently still in its infancy, there are grounds to expect instances of highland DSS development and application to proliferate in the future.

5.5 Locating the IWRAM project

In 1997, a three year research project was launched which aimed to develop an Integrated approach to Water Resources Assessment and Management (IWRAM) in the Ping Basin in the Northern highlands of Thailand. This section describes the original intent and collaborative structure of the IWRAM project according to the funding proposal which was accepted by the Australian Council for International Agricultural Research (IWRAM 1997). Over time, the objectives and methodology of the IWRAM

project have altered, however the following description is relevant for the period of this thesis.

The central objective of the IWRAM project is to develop participatory and analytical approaches to assist stakeholders to identify and assess options for highland resource use which provide for more sustainable development, by better promoting the inhabitants' socioeconomic and cultural welfare, while minimising impacts such as soil loss, flooding, drought and downstream water pollution. Key outputs of the project are intended to be a DSS and a participatory decision making framework.

The IWRAM project is a cross-cultural collaboration between an Australian research team and Thai academics and government personnel. The Australian researchers participating in the project are drawn from the School of Resource Management and Environmental Science in the Australian National University, and incorporated researchers whose fields of academic expertise include economic analysis, social impact assessment, catchment and groundwater hydrology, digital elevation modelling, and modelling of erosion processes, climate and agricultural systems. The Thai researchers in the project are drawn mainly from the Department of Land Development (and its Office of Highland Development), the Royal Forestry Department, Chiang Mai University, Maejo Agricultural University, and Kasetsart University.

The Thai collaborators are co-ordinated under the umbrella of the Royal Project Foundation (RPF). The RPF was established by King Bhumibhol in 1969 as a model of creative and compassionate development which would promote security through replacing opium and slash-and-burn cultivation with permanent cash cropping. Although the RPF is cast as a non-government organisation, in practice, it is only semi-autonomous and semi-detached from the politics and development constructs of the state bureaucracy. One reason for this is that the RPF depends largely on government allocation of funds to maintain their activities (Gohlert 1991:39). Another reason is that RPF personnel tend to be drawn from government agencies which assign staff as 'volunteers' to the RPF, and tend to mirror the prevailing development ethos of their base agencies. It should be noted that treatment of the King as beyond reproach tends to preclude public critical evaluation of the Royal Projects. Privately, several development workers have expressed reservations about the viability of the Royal Project approach, pointing out that the programmes are sustained through a continual injection of funds which subsidise marketing, sales, crop inputs among other services and material resources.

The IWRAM project comprises four interlinked research components: biophysical, sociocultural, economic and decision support. The four research components are integrated through common focal sites, and through information transfers. Management options generated through participatory processes undertaken by the socio-cultural component will be used as inputs to the biophysical land-use management simulations. This is intended to ensure that management options being modelled are 'real' and perceived as desirable by the different stakeholders. To provide feedback to the stakeholders on the benefits and costs of different visions and options for land use management, information from the biophysical component and the economic component on agricultural benefits will be fed into the stakeholder process. Also, information from the biophysical component on flood stage height, water quality, dam

siltation and crop yields will be used in the economic component to calculate benefits and costs, including losses in land productivity.

The DSS component serves a key role in the integration of the IWRAM research. Firstly, the DSS to be developed will map different stakeholder's visions and constraints for the Basin. Secondly, databases and biophysical and economic models will be integrated in the DSS. Finally, the DSS will perform simulations, visualisations, trade-offs and optimisations of the biophysical, economic and social effects of different land and water use scenarios. The DSS is intended to incorporate spatiotemporal databases at two scales: a basin-wide scale based on a grid of about 100 m; and a focus-catchment scale with a grid of about 20m. The databases will include: digital, spatially referenced, gridded land cover data; a grid-based Digital Elevation Model; and digitised geological and soils data. Models or relationships of and between climate, landscape, land use, demography, agricultural productivity and environmental costs will be incorporated as modules in the DSS. A central feature of the DSS model-base is an integrated biophysical modelling system which will enable assessment of the hydrologic impacts under different land use, rainfall and temperature scenarios. Submodels intended to be incorporated in the DSS model-base include a precipitation-runoff model, an in-stream routing model, empirical agricultural and forest productivity models, a numerical groundwater flow model, and erosion models

It is envisioned that the DSS will be used by the various management agencies to make more informed decisions about land and water use options in the highlands of northern Thailand. Other academic and NGO stakeholders will be able to use the DSS as well as other research outcomes to assess the impacts of management decisions and inform the political process from their own perspective. For individual stakeholders and non-technical users such as farmers and hill tribes' people, it is intended that the output of the DSS in terms of appropriate land use and management activities would be communicated in extension activities by the Royal Project Foundation and the Department of Land Development.

To assist integration between the researchers and stakeholders, a participatory procedural framework has been developed, Figure 5.3, which encourages active involvement by the stakeholders in the research process. It is intended that stakeholders will have regular input into the research through interaction with researchers in the course of their eliciting visions and discussing possible options, through regular stakeholder workshops held throughout the project, and through additional meetings of government stakeholders convened by the Royal Project Foundation. It is also anticipated that where possible, stakeholders will participate in the collection, presentation and analysis of information.

Through the participatory process, it is intended that highland local communities will gain a greater direct say in policy development and land use planning. It is also hoped that the participatory strategies will enhance ownership by the end users of the processes and methods to be developed during the project, and support the implementation and further development of these processes and methods beyond the life of the project. The participatory process is intended to surmount conventional problems of bureaucratic fragmentation, with the participatory and collaborative approach facilitating communication and coordination among government departments, and encourage co-ordinated development of policy and goals. It is also intended that the collaborative

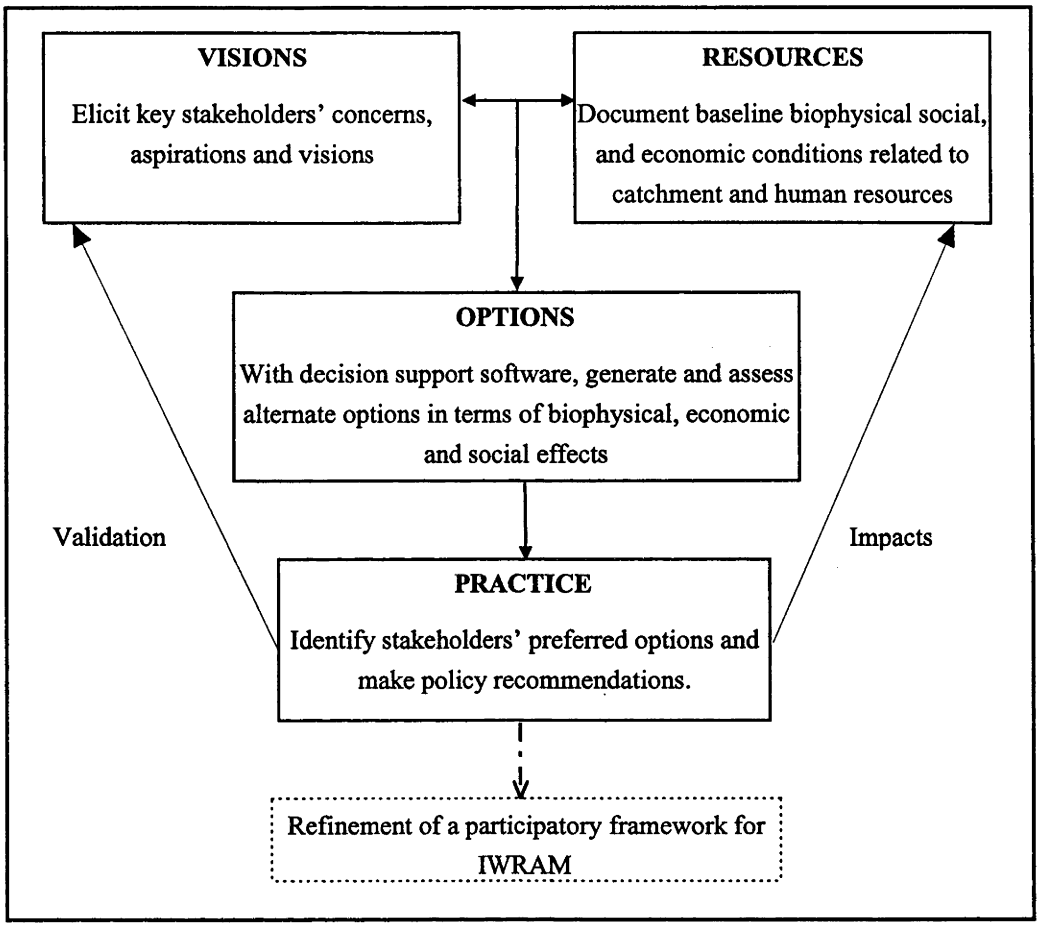


Figure 5-3 Procedural framework of the IWRAM project

structure of agency volunteers co-ordinated under the umbrella of the RPF will facilitate co-operation and dissuade interagency rivalry, and that integrated management will be promoted through delivery of a more holistic information base for policy development and regional planning.

The integrative research and procedural frameworks and the collaborative arrangements, particularly the RPF umbrella structure and the inclusion of sociocultural researchers from the outset, illustrate that the IWRAM project is making a concerted effort to confront the challenge of more effective co-ordination and participation. In this manner, the IWRAM project may prove an innovative departure from previous development efforts. However, the IWRAM project proposal also suggests several similarities with previous development projects, including reinforcement of a rationalist paradigm of management through an emphasis on biophysical and economic productivity, and some references to conventional extension and transfer of technology models.

5.6 Politics of highland decision support: Anticipating bias

The IWRAM DSS is intended to assist all stakeholders in highland environmental management to make better decisions for sustainability. A key issue is whether sociocultural networks of influence and commitments engaged during development or use of the IWRAM DSS may bias the DSS in favour of one set of stakeholders over

another. Informed by the historical, environmental and political context detailed earlier, this section draws on the taxonomy of bias proposed in Chapter 3 to explore potential biases of the IWRAM DSS. The aim is to foreshadow case study issues and to demonstrate that biases are significant and worthy of consideration within this setting.

As evidenced by bureaucratic fragmentation, inter-agency and intra-village conflict, neither state nor village discourses on environmental decision-making are monolithic. None-the-less, literature suggests that themes may be synthesised from each set of discourses enabling a contrast of dominant state and village perspectives. From a critical standpoint, this characterisation is useful to indicate plausible, alternate ways of framing highland decision-making problems and solutions, and suggest potential biases in the IWRAM DSS in terms of which (and whose) logics may underpin the system. As illustrated through the narrative of the history of the highland decision-making environment, the dominant state discourse of highland development has tended to be embedded within security commitments and predicated on notions of territorial control. Over the past two decades, environmental conservation and sustainable environmental management have been employed to extend the metaphor of control and reinforce state claims to the highland resources. Environmental decision-making for the highlands has been framed as a national policy issue, necessitating a balance between the economic, environmental and social welfare of the nation as a whole versus that of individual highland communities. The highland environmental problematique has been linked to the destructive character of traditional highland swiddening systems, particularly opium cultivation. Solutions have been couched within western-derived theories of modernisation, economic integration, and optimal productivity through intensification, and attempts to enforce the separation of people and nature. In contrast, many highland communities locate environmental concerns within the context of increasing livelihood pressures, including the on-ground implications of solutions promoted by the state (Pratuang 1996:120). The mobilisation of environmentally-oriented community networks, partly in response to state threats of relocation, represent discursive claims for a stronger voice in highland decision-making. In contrast with state strategies of relocation and concomitant cultural dislocation to ensure environmental preservation, local analyses tend to place environmental management within the framework of cultural beliefs and customs (Pratuang 1996:123). Within locally-centred discourses, a key dimension of potential solutions often involves recognising and revitalising a role for traditional forest protection practices.

By framing more sustainable development as better promoting the inhabitants' socioeconomic and cultural welfare, while minimising impacts such as soil loss, flooding, drought and downstream water pollution, the IWRAM project is attempting to bridge the perspectives presented above. However, the relative ease in incorporating commitments to logics underlying the state versus the local perspective suggest a potential bias. Scientific forest and land classification systems employed by state agencies may be contrasted with an indigenous Karen forest and land classification system. The former system is based on a set of universal criteria to evaluate biophysical properties of land and soil, including terrain, slope, soil type, soil texture, moisture, salinity, erosivity and organic matter content (Santita 1996:251). These criteria enable assessment and classification of forest and land parcels, including allocation of conservation forest, which is considered unsuitable for human settlement, and economic forest, which is deemed suitable for productive commercial exploitation (Pratuang

1996). The quantitative character of the state criteria makes them amenable to computer manipulation, and the spatial allocative character of land evaluation is amenable to G.I.S. representation. Furthermore, the resonance of the state approach with dominant western approaches promotes incorporation due to familiarity.

While the indigenous evaluation incorporates some of the scientific state criteria, it differs in its emphasis on sensory perception and symbolic interpretation rather than quantitative measurement (Santita 1996:251). Whereas the scientific evaluations are predicated on standardisation of physical criteria, the indigenous system frames land and soil evaluation within the context of local livelihoods and culture. For example, Karen in the Mae Wang watershed classify forest into seven types, including upper watershed forest, which must be preserved to appease the resident spirits, but from which villagers may collect wildfoods and herbal medicines (Pratuang 1996:124). The symbolic, qualitative, spiritual and sociocultural basis of the indigenous evaluation process suggests that it may be more difficult to incorporate within a computer-based DSS. Kampe (1992) and others have argued that the predominance of westernised scientific knowledge and economic market ideology over indigenous knowledge and subsistence systems has resulted in a loss of tribal culture and self-esteem, and have undermined participation in decision-making. Similar disempowerment may result if the former knowledge is validated within the DSS, while the latter is absent. As Marglin (1990:10) warns, "The adoption of colonial values by Westernised indigenous elites stacks the cards against tradition. It hardly helps if Western values are expressed as universals which cut across cultural boundaries". The likelihood of biases due to incomplete knowledge is reinforced by a comment from a foreign volunteer working with a development NGO in the communities in the Northern highlands, describing how their organisation had experienced difficulties with a recent computer-based evaluation of their programme: "They used the 'Logframe' process of evaluation. We were speaking different languages. They were focussed on quantifiable indicators, the NGO was talking about process and qualitative measures that didn't lend itself (sic) to the logframe procedures"[22]. While many aspects of the indigenous system appear not to be amenable to incorporation in the DSS, the proliferation of 3D topographic models throughout highland villages suggests that, like the state system, the indigenous system may be referenced spatially, enabling G.I.S. representation.

The constructionist argument presented in Chapter 4 suggests that an interrogation of which perspective is likely to be incorporated rests largely on the question of who is likely to own the process of DSS development. Johnson (1985) argues that since the process of selecting and developing computer-based technology usually occurs at the instigation of those at the top of the organisational hierarchy, then the construction of that technology will largely depend on the motivations of these people. Kling (1974:279) notes that within organisations where there is dissension about goals and methods, designers tend to accept the professional ideology espoused by high level officials, partly because the latter's support is usually necessary to implement the information system. He thus provocatively suggests that designers of computer-based information systems "act like hired guns who are merely servants of groups with established power". Supporting these arguments, Winner (1989) draws on empirical studies of computers and social change to conclude that "those best situated to take

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[22] Personal interview with Karan Aquino, 18 November 1997

advantage of the power of a new technology are often those previously well situated by dint of wealth, social standing and institutional position". This conclusion echoes classical theories of organisational power, as articulated by sociologist Max Weber: "The bureaucratic structure goes hand in hand with the concentration of the material means of management in the hands of the master" (Weber 1946). Given the long tradition of political, socioeconomic and educational advantage of state officials over highland villagers, the preceding perspectives reinforce the likelihood that state agencies will own the process more than highland villagers, and raise the potential for the DSS to be used by the established elite to sustain and enhance prevailing power inequities.

Thus far, the discussion has been based on a broad comparison of state and village stakeholder groups. Further biases would emerge from further disaggregation of these groups. For example, analyses of intra-village conflict by Waranoot (1995) and others suggest that different village groups are likely to have alternate framings of the decision problem, partly dependent on their location in the catchment relative to other villages, and their history of land use. Amongst the state agencies, the historical conflict between the core interests of the Department of Public Welfare and those of the Royal Forestry Department indicate alternate state framings of the highland problem. The DPW has traditionally been concerned with enhancing the welfare of the highlanders, the RFD has been concerned with the preservation and productivity of forests. Given such conflicting framings, and in light of the tradition of interagency rivalry, the potential arises for DSS development to be hijacked by one department to reinforce its political sphere of responsibility and influence. If this occurs, then the exclusion of certain agencies in DSS development may lead to biases due to incomplete knowledge, distortions in knowledge, or commitments to certain logics. Fragmentation and non-coordination of bureaucratic agencies with an interest in highland environmental management suggests that biases due to incomplete knowledge may also arise because of difficulties in gaining access to data. As Anat et al. (1987:304) suggest, "In a world where different agencies see themselves in competition for resources and influence, information is seen as power... it may be difficult to persuade them to share the information they have and to co-ordinate the data they collect in the future". The quality of highland data, which is seldom rigorously documented methodologically and is frequently conflicting when triangulated, introduces further potential for biases due to incomplete knowledge or distortions in knowledge.

A tendency for computer power to be consolidated within central agencies in Bangkok raises potential for biases in access due to geographical constraints, potentially biasing against both regional state agencies and highland villagers. If the DSS was located in a regional office in Chiang Mai, access may still be constrained for those villagers living in remote communities. Installing the DSS on a portable laptop might surmount these geographical constraints if the agency maintaining the system was willing to travel to the remote villages. Although the expansion of the road network in the highlands has increased the accessibility of many highland villages, it is still necessary to access some villages by foot. Even for those villages connected to the road network, during the rainy season, roads are often hazardous and difficult to traverse except by four-wheel drives. An alternative favoured within many western countries would be to link computers located within highland villages to a central DSS. Limitations in terms of the availability of electricity in the highlands suggest a further impediment, necessitating a reliance on batteries. This latter point raises an issue which was not incorporated within

the theoretically-derived taxonomy of bias, as the literature addressing computerisation and access issues is predominantly from developed countries where electricity supply tends to be assured.

If the user interface of the IWRAM DSS is in English, then access would be constrained for potential users who are not literate in English. Translating the DSS into Thai would enable agency personnel to use the system. However, access would still be constrained for many highland people since only about 59% can speak Thai, and around 74 % of hill people have no access to formal Thai education (Kampe 1992:159). The dearth of computer literacy within regional and local government agencies beyond simple word-processing tasks suggests that even for these Thai-literate stakeholders, access is likely to be constrained unless computer training is provided. The limited conventional and computer literacy of highlanders raises the issue whether equitable access may be better promoted through ensuring alternate forms of interacting and interfacing with the output of the DSS rather than endeavouring for open computer-based access. However, it should be noted that some highland villagers have expressed an interest in receiving computer training, as they perceive that, as with conventional mapping technology, the DSS may be appropriated to enhance their authority and credibility in negotiations over contested resources[23].

Yet not all highlanders are equally enthusiastic about computer technology. One NGO volunteer described a pilot project they had initiated in a highland village where GPS and a simple GIS were used to map the village resources: "It was time consuming - sometimes it would take an hour to get a signal through the canopy - we didn't get one village let alone the three we had planned. At the end of the day, we would link a laptop up to a generator and draw maps. I'll take a picture home in my mind of sitting in a Karen house lit by candlelight while the Karen villagers old and young sat around watching the computer create the map. But in the end, we stopped running it, because as we got more information, it took longer and longer to create the maps. And the novelty value wore off for everyone. We don't know what use it will be - except that it is good for the villagers to know what is out there". This comment suggests that the relevance and efficiency of the technology for the villagers was questionable, and emphasises local heterogeneity in responses to technologies.

If the IWRAM DSS achieves its objective of assisting in identifying more profitable resource management systems, and if users are required to pay for access, then the DSS will provide an economic advantage to those stakeholders who have the wealth to access the DSS. Hence, as with previous development efforts in the highlands, the IWRAM DSS may serve to introduce or exacerbate economic and political disparities. The historical disparities between the conventional opium cultivating and pioneer swiddening tribes versus the conservationist Karen would seem to implicate ethnicity as a significant factor to consider in terms of the likelihood of potential biases in access. However, Hinton (1983:159) has argued that as environmental pressures have gradually forced abandonment of 'traditional' cultivation practices, ethnicity has become increasingly irrelevant. Instead, he argues that economic and political interests have emerged as more significant. Thomas (1995:15) similarly notes that although behavioural responses to introduced technologies "are increasingly similar among various communities and ethnic groups, research already indicates that there are

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[23] Interview with Prathuang Narintarangkul na Ayuthaya, November 1997

differentials among households within communities". This supports consideration of intra-community economic and political differences in an interrogation of biases in access. However, results from a study by Dearden et al. (1996) suggest caution in abandonment of consideration of ethnic difference. Drawing on interviews with villagers inhabiting the Doi Inthanon National Park, Dearden et al. (1996:127) note that while 29% of Hmong respondants indicated that they not only had sufficient income to meet their needs but also had some savings, "only 9% of the Karen were in this position, with 63% indicating that they had insufficient funds and 47% indicating that they were in debt".

Even if villagers are provided with access to the DSS or the DSS output, the potential exists for the DSS to perpetuate the extension of state control and influence within a village, leading to the political disempowerment of villagers. Hirsch (1990:30) describes this fundamental tension of increased local participation and access: "On the one hand, integration of village institutions into supravillage structures gives villagers potential access to supralocal resources and influence over decisions affecting them that are made at a higher level. On the other hand, the penetration of State and capital into the village that is a concomitant part of this process transforms village institutions in such a way that they take on state functions or are reduced to monetised relationships within the larger economic system. This reduces village control over local resources and decisions in deference to state power, which itself falls into the hands of powerful individuals within the village". If embedded biases are obscured, political disadvantage may be compounded. In this vein, it should be noted that the historical employment of education within highland communities as a means to promote assimilation and extend the state worldview suggests that development of DSS within a learning paradigm may not be benign. Instead, the use of a DSS as a tool for learning may explicitly or implicitly educate highlanders to think about highland problem-solving, including what the problem is, and what factors should be considered, in a way determined by external observers as correct.

The preceding discussion suggests that on several dimensions, there is the potential for the IWRAM DSS to be biased against highlanders, particularly poorer, more remote and already marginalised communities and individuals.

5.7 Conclusions

The implications of the use of environmental DSS for the decision-making environment of the Northern Highlands of Thailand are uncertain. On the one hand, DSS may provide a means of improving access of traditionally disempowered stakeholders to information, thereby minimising inequity and facilitating informed community participation in environmental decision-making. On the other hand, DSS may represent a means of perpetuating and reinforcing existing power inequities and conventional developmental biases through recourse to politically fashionable and convenient environmental rhetoric. For example, historical tendencies towards extreme centralisation and patriarchal rule, together with the remoteness of many highland villages, widespread illiteracy and persistent low incomes within highland villages point to potential biases in access. Meanwhile, a tradition of bureaucratic elites controlling the expertise and tools of power, and stark differences between the epistemological foundations and modes of classification associated with bureaucratic and local knowledges raises the potential for socially embedded biases. For the IWRAM project,

a challenge is whether and how the processes of developing and implementing a DSS for the Northern highlands may be constructed to minimise potential biases. Chapter 6 describes the process by which the IWRAM researchers engage with the frameworks proposed in Chapter 4 to reflect on potential biases associated with the development and use of the IWRAM DSS.

Framing environmental decision support and anticipating biases

Over the past decade, there has been increasing investment in and development of highland resorts by lowland Thais. The highlands are an attractive resort location because of the cooler temperatures, and because, despite the deforestation, the highlands still have a higher proportion of forest than any other region in Thailand. Highland villagers argue that the contribution of resort construction to the deforestation problem is often underemphasised in public debates.

6. Framing environmental decision support and anticipating biases

6.1 Introduction

The purpose of this chapter is to present a case study of the use of the analytical framework, proposed in Chapter 4, to guide reflexive and precautionary DSS development in the IWRAM research project. Figure 6.1 introduces the participants who feature in this and subsequent chapters[24]. The mode of presentation is a narrative of the evolution of the IWRAM project, concentrating on events which inform or comprise the framework application. The narrative approach has been selected for several reasons. Firstly, placing use of the analytical framework within a narrative of the IWRAM project evolution emphasises that the process did not take place within either a sociopolitical or perceptual vacuum. Instead, each participant engaging with the framework entered each phase of the process with preexisting ways of construing environmental decision support, the highland decision-making environment and DSS.

Secondly, a primary aim of this chapter is to communicate how different researchers' perspectives on the nature and role of decision support, the IWRAM DSS, and the decision-making environment, shifted and evolved over time. The narrative provides a means of tracing this history, and a pointer to how different sociopolitical events may have crystallised, altered or otherwise influenced different researchers' perspectives[25]. In particular, a chronological treatment of the group dialogues that comprised part of the framework application illustrates the process of construing and reconstruing in practice, and informs the evaluation of the framework, presented in Chapter 7.

A narrative of the evolution of the IWRAM project also serves to illustrate the cascading impacts that happenstance and apparently incidental decisions may have over time on the conduct of a research project, and thereby on the character and form of the research outcomes, which in this instance included the DSS. In particular, the personnel who became involved in the project, the reasons why they became involved, their roles in relation to development of the DSS, and their familiarity with or commitment to particular software or methods, all emerged as factors which contributed to shaping, and thereby potentially biasing, the purpose, form and content of the DSS.

Section 6.2 recounts how the scope and design of the IWRAM project unfurled, and how the IWRAM DSS took shape within it. Sections 6.3 and 6.4 describe and analyse the use of the analytical framework with the Australian and Thai IWRAM research teams, respectively. These sections provide insight into the differing ways that participants construed decision support, and the potential biases that each participant identified. Section 6.5 describes and analyses a joint team meeting between the

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[24] During the time of my involvement with the IWRAM project (1995-1997), the roles of several participants changed. These changes are indicated in Figure 6.1. The underlined roles signify the name(s) by which each participant is referred to within the narrative. Further changes in participants' roles which occurred subsequent to my involvement with the project are not indicated.

[25] Note that this mode of presentation resonates with Kemmis and McTaggart's (1988) advocation of revelation of a group's critical history, as referred to in Ch 4: Reorienting DSS development.

Australians and Thais which provided an opportunity to share each team's vision for the DSS. Finally, Section 6.6 notes several developments within the IWRAM project which unfolded after my interaction with the project had ceased, where these developments had significant implications either in terms of shaping the IWRAM DSS, or in terms of the effectiveness of the analytical framework.

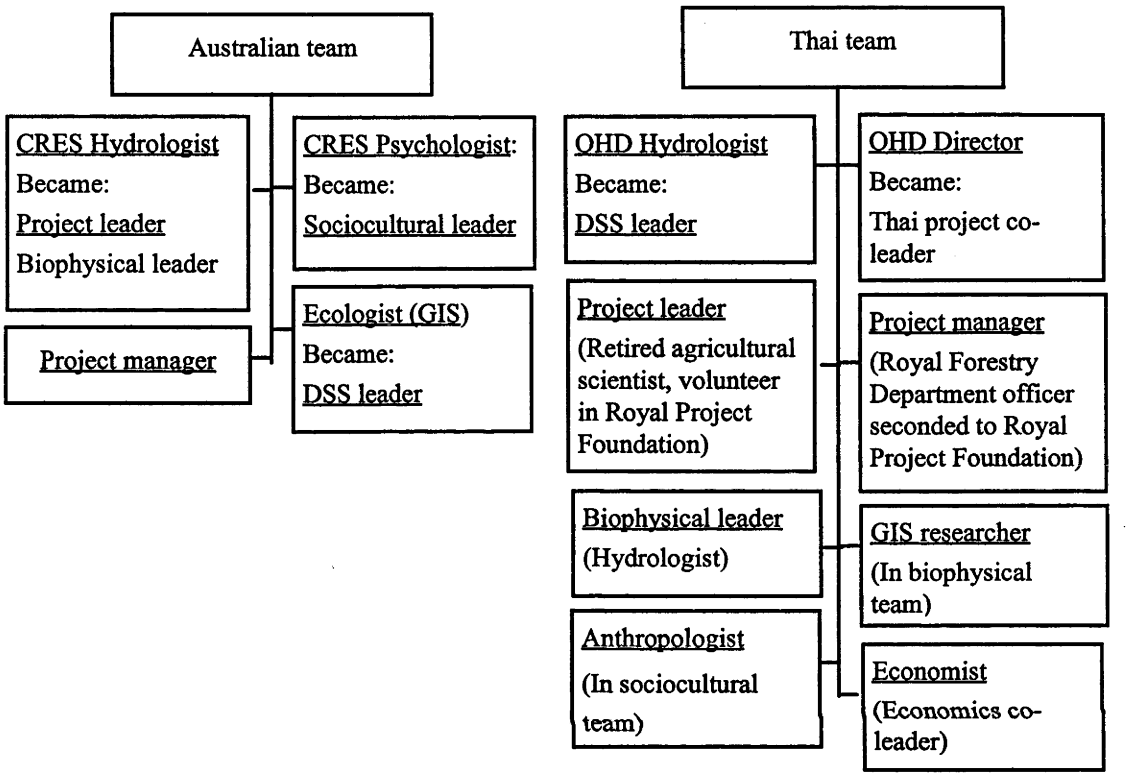

Figure 6-1 Collaborators in the IWRAM research project referred to in narrative

6.2 The unfurling of the IWRAM project and DSS

The Centre for Resource and Environmental Studies (CRES) is a research institution within the Australian National University, Canberra, Australia. In 1994, two academics at CRES, from the research backgrounds of environmental psychology and quantitative systems modelling floated the idea of collaborating together in an interdisciplinary project of mutual interest. Although CRES officially promoted itself as an interdisciplinary research body, it was widely perceived that in practice few projects of an interdisciplinary nature had been undertaken. Hence, a key motivation for developing such a project was helping to build up CRES' strategic initiative in interdisciplinary research. For each of the academics, interdisciplinary collaboration also promised opportunities for professional development.

After some discussion, a project was identified which combined the research interests of several academics in CRES: developing methods for an integrated assessment of management options for sustainable development of the water resources of the Chao Phraya Basin, Thailand. The project was framed as a pilot project, with a view to later

transferring the integrated framework developed to other Asian river basins. The CRES modeller and psychologist assumed the reins as project co-leaders, and began a search for opportunities to attract funding of the proposed project.

Independently of the plans to develop a project at CRES, a hydrologist at the Office of Highland Development (OHD) in Thailand had begun developing a project to integrate land use planning, hydrological modelling and GIS at the catchment scale. The OHD is an agency within the Department of Land Development (DLD) with responsibility for land use planning and allocation in the highland regions of Northern Thailand. In mid-1995, a Thai government delegation, including this hydrologist as well as the then Director of the OHD, visited CRES on the suggestion of the incumbent Director of the DLD, an old friend of the Director of CRES[26]. During the visit, details of each of the proposed projects were shared. The Thai hydrologist emphasised his interest in determining the type of land use cover which would improve the land and water quality of a catchment, particularly in terms of streamflow, channel erosion and base flow. The Director of the OHD spoke of the cultural and political context: how opium was a competitive crop and opium replacement crops needed to be similarly competitive to succeed; and how some generations back, strong, rich men had taken the best land, forcing the less powerful to roam the highlands exploiting the poorer land to survive.

Over the course of the Thai visit, the CRES modeller and OHD hydrologist further developed the OHD project with a view to collaboration. The OHD Director was strongly supportive of engaging in collaborative research with CRES, not least because his son had recently moved to Canberra for schooling. He suggested that a friend in the Royal Project Foundation (RPF) might be willing to sponsor a collaborative project. The OHD Director later explained the perceived political benefits of locating the project under the auspices of the RPF. Firstly, he thought that the non-governmental status of the RPF, and the association of the RPF with H.M. Bhumibol Adulyadej, King of Thailand, would facilitate more broad participation within the project, including government officials, academics and other stakeholders. In particular, it would provide a means of overcoming traditional non-cooperation between stakeholders, particularly that due to intergovernment agency rivalry. Secondly, he thought that the extension arm of the RPF would provide a means for immediate delivery of the project outcomes.

After further interaction over the ensuing months, it was proposed that the original OHD and CRES projects be merged into a combined project which would develop an integrated framework to assess options for the sustainable management of land and water resources for the headwaters of the Chao Phraya, the Ping, Yom, Wang and Nan, which all originate in the highlands of Northern Thailand. This provided the genesis of the IWRAM project. A quest began to seek funding from the Australian Council for International Agricultural Research (ACIAR) for components of the project.

In October 1995, a CRES delegation, including myself, visited the OHD, DLD central office in Bangkok, and several other government departments and universities. During discussions at the OHD, the OHD hydrologist described two extreme strategies that the government could take in relation to the highlands, both of which were undesirable. Firstly, people could be allowed to exploit land as much as they wished, which would have severe environmental ramifications. Or, to protect the watershed, communities

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[26] My involvement with the IWRAM project commenced shortly before this visit, see Section 2.3.

could be forcibly moved out of the highlands; an approach that in the past had proved controversial because of the adverse social impacts experienced by the dislocated communities. Against this background, the primary research question the OHD was interested in was: "How far can we exploit the forest in each catchment and turn it to cultivated land while still protecting downstream water and land resources?" Thus, from the Thai perspective, the project was firmly embedded within the political complexity of highland environmental decision-making, and framed in terms of reconciling different stakeholders' interests.

The CRES visit coincided with devastating flooding throughout Thailand. One suggested response to the flooding which was widely publicised was that the Royal Irrigation Department (RID) be provided with money to build another large dam to trap the floodwaters. The Director of the OHD saw an opportunity for the joint project to take advantage of the political climate: "We want to support our office OHD - to get political support that if we fix the soil on the mountain, it is cheaper than giving RID money to clean up the stream". The OHD Director felt that activities directed at restoring the highland environment would address the source of downstream water quantity and quality problems, and be more effective than expensive remediation efforts. Note that an institution building motive has emerged for the initiation of the IWRAM project.

The precise origins of the decision to develop a DSS as part of the IWRAM project are uncertain. Most reports trace the origin back to a suggestion by the CRES modeller, following a project workshop held in December 1995 in Chiang Mai. However, the development of the DSS appears in the preamble to that workshop as one of the project objectives, and thus must have been conceived of sometime in the months preceding the workshop. The CRES modeller recalls that he initiated incorporation of the DSS because he felt it would be a good vehicle for integrating the project, that it would give long-term memory of the project, and that it would provide an opportunity to initiate research within CRES into DSS. In the context of the latter rationale, he framed the DSS as a transferable computer-based technical tool. Meanwhile, the OHD hydrologist recalls that the DSS was initiated to promote greater efficiency. He explained that "The ideal situation is that development options are explored from every possible dimension or discipline. In real life, planners always have weak and strong points. The technology should help them get over their weak point with less time and effort. And get over their strong point in much faster time". Thus, at this stage, the OHD hydrologist framed the DSS as a tool to allow planners to consider a wider spectrum of factors more rapidly.

The Phase 1 proposal, essentially a concept paper, for the IWRAM project was submitted to ACIAR in early 1996 (IWRAM 1996a). Box 6.1 reproduces excerpts from the proposal which illustrate how the IWRAM project and the DSS were framed at that time. It should be noted that the CRES modeller and psychologist were respectively identified in the Phase 1 proposal as leaders of the biophysical and sociocultural components of the project. From this point onward in the narrative, they will be referred to as the biophysical leader and the sociocultural leader.

Although the review of the proposal by ACIAR was supportive, they insisted on several revisions to address concerns about the scope and focus of the project. Among their concerns were that the project needed to address a policy issue and not be driven purely by academic interests, and that a smaller catchment be selected for the project case study

than the whole of the Chao Phraya headwaters. In response to these concerns, the Phase 1 proposal was revised to focus only on the Ping watershed, and to articulate the research more strongly in the context of the central policy issue, namely 'Which patterns and intensity of cultivation and other water use in the highlands of Northern Thailand's Ping Basin provide for sustainability in terms of promoting the soicoeconomic and cultural welfare of the inhabitants, while minimising soil loss, flooding and drought, and preserving downstream water quality?' (IWRAM 1996b). The revised Phase 1 proposal was formally accepted in March 1996.

It should be noted that at this stage, the ACIAR proposal was not perceived as defining the boundaries of the IWRAM project. Instead, the research ambit of the project was broad, incorporating social forestry, groundwater, biodiversity and climate change issues, reflecting the diverse research foci of various CRES academics and others within the School of Resource Management and Environmental Science (SRMES) who had become interested in participating in the interdisciplinary project. Accordingly, the ACIAR proposal was merely viewed as providing funding for one portion of the project.

Box 6-1 Framing the IWRAM project and the DSS: February 1996

> The project comprises three interlinked research components: sociocultural, biophysical and economic.
>
> The sociocultural component aims to identify key stakeholders' aspirations for highland development, assess social and cultural impacts of land and water use, and generate alternate land and water use options with stakeholders.
>
> The biophysical component aims to simulate the effects of water and land use options and climate on soil loss, agricultural productivity, stream quantity and quality, accepting as simulation inputs the management options arising from the sociocultural stakeholder process.
>
> The economic component aims to calculate on-site benefits as well as on-site costs of land and water use, using outputs from the biophysical component.
>
> Integration of the research components is intended to be facilitated by the concurrent development of decision support software and spatio-temporal databases to perform basin-wide simulations of the biophysical, economic and social effects of land and water use options.
>
> *Excerpts from IWRAM 1996a*

The Phase 2 proposal required a detailed project description, including methods, objectives, expected outputs, a full budget, and the specification of personnel and their responsibilities. At this stage, collaborative arrangements were still tentative. The OHD Director assumed responsibility for negotiating with prospective Thai collaborators. Some collaborators were brought on board because, as well as having reputations and experience in highland development, they were, or had connections to, friends or relatives of the OHD Director. Others were invited to collaborate because of their political positions, including the Office of Narcotics Control Board, which controls certain sensitive socioeconomic data. In many cases, association with the Royal Project Foundation was emphasised as a reason to become involved. In terms of the sociocultural collaborators, the OHD Director decided to approach a high profile social scientist who had in the past publicly supported political positions in favour of the highland people, and in direct opposition to the OHD Director. The OHD Director explained that he thought that joining people from the opposite sides of the old protests

under the RPF umbrella would be critical if the IWRAM project was to represent a new, participatory and collaborative approach. After a terse meeting in which the social scientist stressed that he would not be coerced into following a government line, he agreed that he and his team would participate.

An email exchange during the preparation of the Phase 2 proposal between the sociocultural leader and one of the new Thai sociocultural researchers outlines their hopes for the project. Noting that the draft proposal methodology describes an intention to include all key stakeholders in natural resource management and social impact assessment, the Thai researcher remarked that:

> The development of participatory planning system and methods, in which villagers and local officials have more communication and coordination, have been researched and experimented by some highland development projects in the last 5-7 years. Many good models and systems were developed but these stopped when the project terminated. Unchanged centralised legal and structural framework and system still obstruct the people's participation in natural resource management on a sustainable bases. Do you think with this project we can achieve something beyond the development of participatory approaches and methods, say the improvement in institutional aspects which support the sustainable management of natural resources by all stakeholders?

The sociocultural leader responded that she had a dream that the process of asking stakeholders their visions and discussing options could provide a way of "getting better communication within and then between government departments..., encouraging the government departments to open up better dialogue with the non-government stakeholders, particularly local people..., encouraging the government departments to use the processes we develop through the project as part of their ongoing management practice". As will emerge through the course of this narrative, this exchange may be viewed as an early signal of an alternate way of construing the DSS, namely as a possible mechanism for political, institutional and social change in Thailand rather than as predominantly a transferable, technical tool.

In light of the sociocultural leader's absence on sabbatical overseas, as well as the conflicting professional commitments of other project personnel, the biophysical leader assumed primary responsibility for submission of the Phase 2 proposal, including the development of the budget[27]. At ACIAR's behest, he also became installed as the sole project leader. As will be discussed in Chapter 8, this event was significant because of its implications for the direction the DSS would later take.

Active contributions to the preparation the Phase 2 proposal gradually diminished, as various SRMES academics initially interested in the collaborative project drifted away, many because of more favourable professional opportunities, or time and resource constraints. Some social researchers who were originally involved have commented that their interest waned when they perceived that it would be difficult to maintain and defend a critical and participatory approach from marginalisation by technically-oriented researchers whose worldviews and ways of practice would be challenged by such an approach. Other researchers have commented that their involvement

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[27] Offering an alternate construing, the biophysical leader suggests that he was always the main driver of the project. This version of events does not undermine, but instead reinforces, the analysis in Chapter 8 regarding the shaping of the DSS.

diminished because their research interests did not seem aligned with the strategic priorities of the proposal identified by the project leader. For example, climate change modelling, which was the research domain of one CRES researcher who had been closely involved with preparation of the project proposal until this time, was one of the research areas eliminated from the project proposal in order to keep within the budget limit specified by ACIAR. By this stage, the ACIAR proposal had come to be viewed as defining the bounds of the project.

In the Phase 1 proposal, responsibility for selection and customisation of a DSS, and integration of information into the DSS, had been left floating ambiguously amongst and outside the three project components. During preparation of the Phase 2 proposal, the development of the DSS was made an explicit fourth component of the project. Figure 6.2, drawn from faxed edits to the draft Phase 2 proposal sent from the Australian sociocultural leader to the Australian project leader shortly after the delineation of the DSS component, illustrates the sociocultural leader's suggestion of how the new component should link with the existing components. The Thai hydrologist suggested submerging database development into the DSS component; a suggestion which was roundly supported. No leaders for the DSS component were formally identified, but the Thai hydrologist and Australian ecologist each reinforced their intentions to continue to direct database development in the Thai and Australian teams respectively. The CRES project leader continued to take overall charge of the DSS. At this stage, the aims of the DSS component were to: develop spatiotemporal databases at macro (basin) and micro (catchment) scales; to customise an existent computer-based DSS shell to integrate various environmental modelling tools; and to undertake extensive systems modelling for the Ping Basin of alternate management options. The favoured shell for the DSS was a Canadian tool called RAISON, in part because a recent review of DSS for environmental flows had identified RAISON as one of the most suitable for DSS development (Young et al. 1995). In addition, there was a burgeoning professional relationship between the Australian project leader and RAISON's developer.

During August, further refinements to the proposal continued to shape the nature of the DSS. Firstly, delineating an explicit DSS research component required objectives and methodology for that component to be specified, Box 6.2. Secondly, the need to delineate the Australian versus Thai responsibilities for the DSS saw the Australians proposing to take the lead on building the digital elevation models and developing the land use, land cover, hydrologic and socioeconomic databases; the Thais were assigned to take charge of customising the DSS. Thirdly, the need to specify a leader for the DSS component in the proposal led to the Australian ecologist being installed in this capacity.

In September 1996, the Phase 2 project proposal was submitted to ACIAR for consideration. Over the following six months, there was continual to and fro between ACIAR and the IWRAM team over details of the proposal. During this time, the project leader, sociocultural leader and myself visited a contact of the sociocultural leader, who had designed a spatial DSS called 'LUPIS' to assist land use planning negotiations. Following a demonstration of LUPIS, both the project leader and sociocultural leader felt that this software could potentially be usefully incorporated within the IWRAM DSS to assist stakeholder negotiations and collaborative decision-making.

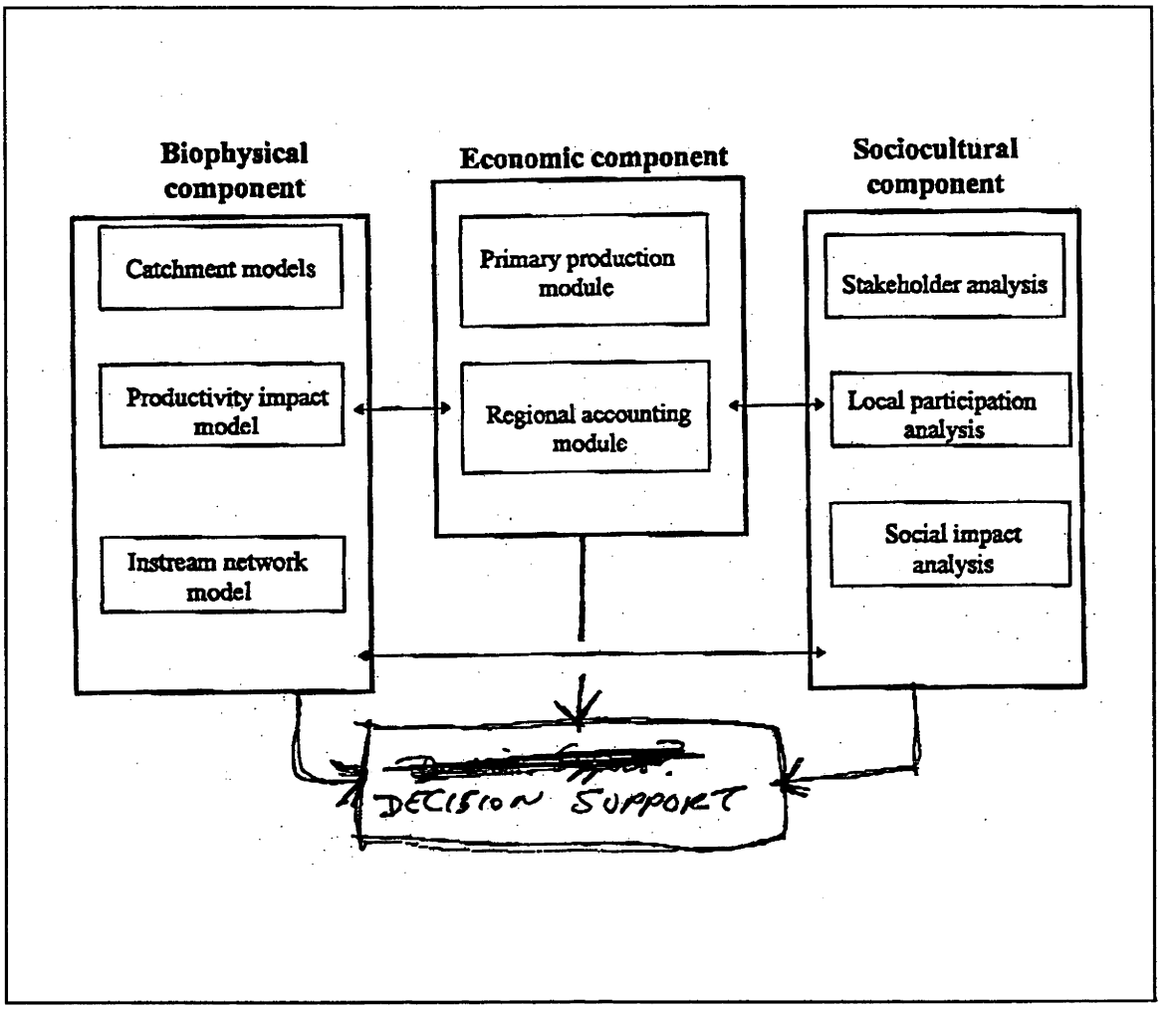

Figure 6-2 Distinguishing a DSS research component, August 1996

Box 6-2 Framing the IWRAM DSS: September 1996

The aims of the decision support component are to:

- develop spatio-temporal databases at both meso and micro scales as part of an integrated framework to link land use, productivity and other physical, social and resource information for the region.
- construct a decision support system to aid research and policy developments for integrated land and water resource management by integrating the spatial database, environmental models and trade-off and optimisation algorithms.
- undertake extensive systems modelling for two representative catchments in the Ping Basin of alternate land and water use and management options in order to assess and visualise their net social benefit, including their externality implications and their impacts on social welfare.
- enhance the applicability of the DSS developed for land and water resource management in the Ping to other basins in Thailand and the region.

The DSS can be used to visualise spatial and temporal inputs and outputs, as well as perform scenario studies with hypothesized inputs. The DSS can also be used to map stakeholder visions or constraints for the different parts of the basin.

(Excerpts from IWRAM 1996c)

6.3 Testing the analytical framework with the Australian team

6.3.1 Testing Part A: Situating the analysis

Part A of the framework for anticipating and interrogating bias was tested with the three Australian leaders of the biophysical, sociocultural, and DSS components during May 1997[28]. Note that Part A is intended to situate the analysis within a particular decision-making environment, see Section 4.7.

Participants' perspectives as to the purpose of the DSS were closely convergent and therefore provide insight into the dominant framing of the DSS held at the time that the discursive interrogation of biases commenced. In describing the purpose of the DSS, the participants all spoke of: assisting decision-makers to clarify options; what-if simulation to allow users to view the impacts of different options; generating better understanding of the consequences of different options; and providing trade-off analysis between conflicting options. These perspectives closely matched the description within the research proposal which framed the DSS as a computer-based tool integrating different models with a GIS database to allow systems modelling of different management options.

Although originally intended merely to situate subsequent discussions, Part A illustrated how consideration of the framework questions may highlight individual or group ignorance and thereby facilitate learning. For example, although one participant was familiar with the broad policymaking environment ("fragmented decision-making by different departments; conflicting, top-down impositions of policy/practices on villagers; business... having relative freedom in laissez-faire political context"), the participants were generally unsure about the nature of the specific policymaking processes that the DSS was intended to support, including whether there were any existing processes by which local communities could give input into decisions. As the DSS leader remarked:

> "This is an important question because we are talking about decision support: raises an important gap in our project planning. We want the DSS to be more than an end-point. We need to be able to integrate it into the decision-making processes... Its important if we want the technology to be more than just a computer".

The topic of potential users of the DSS also revealed uncertainty. In their individual questionnaires, the DSS leader and sociocultural leader had each tentatively suggested that all stakeholders could be users, while the project leader had nominated technical personnel and some policy advisers from government agencies. During the group dialogue, the DSS leader, revisiting the earlier debate about policymaking processes, argued the need to "look at exactly how the stakeholders are actually going to use it" if the DSS was to be incorporated into policymaking processes. Taking up the challenge, the project leader proposed that different groups could use different packages in the DSS, in which case "any groups, except the local landholders because of their literacy level, could use the technology". The DSS leader countered, "But the output of the technology can be presented in other forms like maps for the local people; we are not entirely dependent on a software interface - we will need people to be the human

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[28] Note that funding of the Australian component of the IWRAM project by ACIAR had not been approved yet, but was expected.

interface too". Forestalling resolution of this issue, the sociocultural leader closed this discussion by suggesting that a decision could be made about this matter at some later date.

Group participants were also unsure about how the DSS was supposed to relate to the participatory framework, the other principal output of the project. In both their individual questionnaires and the group dialogue, neither the project leader or DSS leader felt able to comment. In her questionnaire, the sociocultural leader suggested that "I'd prefer it to be subsidiary, adjunct to the participatory stakeholder process, not to dominate it". She reinforced this position during the group dialogue, and raised a possible tension between the DSS technology and a participatory methodology:

> "I would prefer the DSS to be subsidiary to the participatory framework; that is one problem with LUPIS where people are brought to participate around technology rather than a true participatory approach. At most DSS should be a parallel process to the participatory framework - the DSS should illuminate but not substitute for these processes".

When asked what they thought were the major advantages of developing a DSS for this application, the participants all focussed on the users. The sociocultural leader suggested the DSS would help the stakeholders clarify their options, the DSS leader felt that the DSS offered the "ability to present complex science and analysis in a format more readily understood in real-world terms", and the project leader emphasised potential efficiency gains for users.

When asked about the major disadvantages, the participants again focussed on the users, highlighting issues relating to both biased access and embedded bias. In terms of the former, the DSS leader raised the "danger of the system being in the hands of technocrats" (political biases), and the project leader suggested that "the technicality may prejudice the use of it by certain stakeholders" (literacy biases). Revisiting the DSS-versus-participation tension, the sociocultural leader identified the risk that people would be "put off the whole participatory process because it's seen as technocratic". Lighting on a research-versus-use tension, the DSS leader also noted a danger that "we develop an academically interesting system but fail to deliver an operational system". In terms of embedded bias, the sociocultural leader identified a "risk of inequity in what it includes because it is so easy to lean to the measurable" (absences of knowledge), while the DSS and project leaders both highlighted the problem of identifying and communicating uncertainties (absences/distortions in knowledge). The project leader recognised that due to uncertainty, the output of the technology could be misleading, and the DSS leader argued that:

> "we are talking about coupling together many types of models, data - all these errors propagate, when we try and integrate those the challenge is to quantify that uncertainty to stakeholders, who already have enough to deal with in terms of multiple options. But at least we can quantify the confidence of output of the DSS".

However, the project leader feared that it would not be possible to quantify confidence bounds, in which case communication would be important. With the other participants agreeing that communication to stakeholders of uncertainties in terms of both quantitative and qualitative information would be vital, the group discussion closed.

With the benefit of hindsight, this initial discussion foreshadowed many important issues which were to reemerge continually over the course of my research process.

Indeed, the story of shifting constructions about the DSS may equally be reframed as a story of conflict and shifting constructions about how the DSS ought to relate to the current and future policymaking environment, how the DSS ought to relate to the participatory framework, who would be likely or able to use the DSS, and the implications of different users' identities and characteristics for the form and content of the DSS. Intertwined with these issues are the tensions between developing a DSS for research and a DSS which will be used in practice, the dilemma of who should be responsible for considering communication of the DSS output to whom (and when), and the tension between the DSS-as-technology and participatory ethics and methodology.

Shortly after the Australian dialogue based on Part A of the analytical framework had taken place, a summary of the Australian responses was sent to the Thai hydrologist who had assumed practical responsibility for co-ordinating the Thai team. In an e-mail communication to me, he raised several issues regarding the summary, including apparent ambiguity about the scope of the project. Highlighting a potential bias of the Australian perspective, he also noted the absence of population pressures from the Australian list of potential changes in the decision problem over time:

> "A colleague from RFD[29] and I recently discussed this issue. Both of us agree that the key to problem changes is the population pressure. With limited land and water resource [sic], social and economic structures will change over time trying to accommodate more people. In that process people will develop different perceptions, values (or whatsoever [sic] appropriate terms) for their resources. The good news is that population growth is very quantitative and highly predictable. The bad news is that how people react to new constraint is unpredictable... Well, I guess that [Australian] group members grew up in countries where there are very few people and vast unoccupied land".

6.3.2 Testing Part B: Embedded bias

Part B of the framework was tested during July 1997. The group discussion (which included the participation of the recently appointed project manager) explored how the design and development of the DSS might be improved in the light of the collated responses. In particular, participants were asked to reflect on whether any of the identified problems or biases might put at risk any of the criteria for success or advantages of the DSS, or conversely which might increase the likelihood of any potential disadvantages of the DSS, which had been identified during Part A.

Framing the DSS for newcomers

To open the discussion, I asked the project leader to brief the new project manager about the DSS. In his briefing, the project leader concentrated on outlining potential software options that could be customised and integrated to form the DSS, therein indicating his own technical interest and focus:

> "The type of technology we want is not really available - it will need quite a bit of customising and enhancing. Several options - WHAT-IF and RAISON from Canada - doubts about RAISON because of expense, ownership problems. We've been looking at LUPIS - all quite keen on that - allowing us to get stakeholders to input their preferences with respect

[29] Royal Forestry Department

> to spatial land use options... But LUPIS is a bit separate. The main thing is what package we can come up with for displaying our spatial data and linking it up with the modelling. Nothing does that particularly well... So, its looking like we might develop our own system, cobbling together various tools".

Note in the preceding quote how LUPIS, the software to assist conflict management in land use planning, is framed as distinct from the core DSS package which is framed as a technological system which integrates data and modelling.

Following the briefing, the project manager raised the issue of who would be likely to use the DSS. The sociocultural leader responded that she and the project leader "probably view it quite differently - the LUPIS type route - which I'm most attracted to because it's more equitable among users - versus the high powered end of things in what you can represent in a system and I'd be worried about having two systems - one that's more open to stakeholders and one that's more high-powered and techy". Hence, within the context of DSS construed as software, divergent framings were identified, contrasting an equitable, user-friendly approach with a more closed but, technically, more sophisticated system. This suggests recognition that literacy-based biases in access could be potentially problematic in the IWRAM project.

Who should be involved in developing the DSS?

Shifting to focus debate more explicitly on the framework questions, I asked the group to consider the extent and type of involvement of different stakeholders and researchers in the development of the DSS. In their questionnaires, the participants had each expressed a hope that all project researchers and stakeholders would be involved in development from early in the process, however the questions of when and how different people would be involved remained fairly open. In the group dialogue, the project leader suggested those questions could be answered at an impending project workshop. However, the sociocultural and DSS leaders cautioned that questions of when and how stakeholders or users should be involved in development required further discussion about the purpose and nature of the DSS. The sociocultural leader again raised concerns about a conflict between the participatory framework and the DSS, fearful that the DSS might discourage participation in and support for the project by not only highland villagers but also the Thai social science research team:

> "DSS - either people haven't heard of it at all, or it carries different connotations. So on the one hand we're saying we want to get your aspirations, get to know you, help you, and on the other hand we're trying to build this thing that you construe as a very technical, foreign sort of thing. So you are potentially engaging and blowing cooperation at the same time. I think that's the same for the village reps - surrogates[30] - and the research team... Social scientists on the whole don't know much about DSS and are pretty wary of it so those sort of project team members are likely to be wary of the very thing they are being asked to collect data for... I can't see any way around that except to break the principle of consult early... and then you've got the risk of a breach of trust at that point".

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[30] The term "surrogates" refers to spokespeople for highland villagers, such as an NGO representative who has been working closely with a particular village.

Reinforcing his earlier distinction between LUPIS and the technical modelling component of the DSS, the project leader offered a different way of viewing the DSS as a resolution to the apparent conflict:

> "I want to separate out the DSS into two components - a technical modelling system which is one of the inputs into the decision-making process so it's as objective as scientists and economists can make it and includes the options of the social scientists in terms of what we want to simulate... I see LUPIS, however it's managed in a stakeholder setting, as taking the outputs of the modelling component along with all the other preferences that stakeholders have and weighing them up in some way - then I don't have your problem of a big sophisticated tool. I see this big sophisticated tool as something to be seen as very technical and from the start pigeonholed as such".

Note that objectivity is explicitly identified as a goal of DSS development, and that development of the technical modelling system is framed as primarily a task for (biophysical) scientists and economists, with the social scientists' roles limited to provision of information regarding simulation options. In the light of the project leader's earlier description of LUPIS as separate from the main DSS, this quote reinforces his earlier framing of the DSS as a sophisticated and technical tool. The quote also illustrates how, through dialogue, an individual may confront an alternate framing of decision support (a participatory approach which responds to stakeholders' land use planning needs), and attempt to reconcile it with their own primary framing.

The other participants supported the project leader's perspective; the sociocultural leader remarking that it made her feel much more comfortable about the relationship between the DSS and the participatory process. Note that this marks the point where the DSS came to be accepted by the group as involving both a technical modelling component and a stakeholder process component, and that at this stage the latter was technology-driven through its focus on LUPIS[31].

Meanwhile, the DSS leader had argued that they still needed to pin down exactly which decision-making processes the DSS was supposed to be supporting, in particular, whether the Thais intended to put in place an innovative stakeholder based decision-making process to facilitate the flow and use of the information stemming from the DSS, or whether the DSS was destined to be cornered by the top-down government to support the status quo interests. Thus, a distinction was introduced between a DSS to support current interests versus one aimed at future innovations. Note also the implicit recognition of the politics surrounding the use of technology for highland environmental decision-making.

Embedded biases

The next topic of discussion concerned embedded biases. In their questionnaires, the participants had identified several potential forms of embedded bias such as uncertainties in climate surface inputs, biophysical assumptions about discharge and

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[31] The sociocultural leader later commented that although at this stage the stakeholder process was technology-driven, she did not see it as being the sole locus of participation. Instead, she hoped participation could be around issues, although she was having difficulties in seeing how participation could be integrated into the project without being tool-driven.

water quality concentrations, economic assumptions about the calculation of off-site costs, and assumptions about the availability of data to drive the models. During the discussion, a question I posed about how consideration of what would be left out of the DSS might improve the project proved most useful in prompting participants to reflect on means of managing embedded biases. The DSS leader suggested that although modellers tended not to document what they were leaving out of a system:

> "We're talking about information leading to decisions affecting people's livelihoods... and especially if we're using some optimisation procedures, you need to explain to people as part of explaining to people what the limitations are and the limits which can be put on interpreting the results".

Note that in the preceding quote, the practical intent of the DSS, and consequent potential ramifications on those affected by use of the DSS, is recognised. Within this context, the quote suggests an ethical imperative on the part of the researchers to communicate embedded biases.

Both the project manager and sociocultural leader suggested potential embedded biases in terms of absence of knowledge. The project manager noted that the DSS would only be robust within the boundaries of the other three project components and therefore it would be difficult to capture gross externalities like the recent collapse of the Thai baht[32]. The sociocultural leader noted that the content of the DSS would be shaped not only by scoping, or selective inclusion of those factors deemed by the researchers most important and relevant, but also by technical feasibility in that factors not amenable to computational treatment would have to be discarded on those grounds. To manage for embedded bias, the project leader suggested that a document was needed which outlined the limitations of the DSS and how they might influence the model results.

Flexibility of the DSS

In terms of the potential flexibility of the DSS to respond to changes in the decision-making environment, the project leader argued that there would be no problems in upgrading the technical part of the DSS; that models could be changed or recalibrated as new data became available. When asked about the flexibility of the DSS to respond to changes in people's visions and options, he remarked that catchment management groups were used for this task in Australia, but queried the practicality of a similar process in Thailand. This led the sociocultural leader to recognise a tension between developing the DSS for their research purposes and developing a DSS for use:

> "...its one thing to look at where we are in three years time at the end of the project - everything neat for that point in time. In order to be capable of upgrades and to keep the tool relevant, you actually need a monitoring process to be able to be collecting the data to feed in. It's one thing if you've got time series hydrological data being collected anyway, its quite another if you have to fund and organise separate data collection exercises if you had to update visions. So the long term future is a real issue we didn't address in our proposal".

One of her suggestions to manage for flexibility was to consider carefully at the beginning of the project the types of social science data that should be built into the DSS: "I know the temptation will be, having field staff available, to generate a very rich

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[32] baht = unit of Thai currency

database that will be very dependent on more labour to keep updated. The other extreme is to be much more targeted and to say that realistically the DSS is going to need 8 types of data to continue - they are the ones that need to be collected". Thus, a trade-off between ideal process and practicality was introduced with embedded bias implications in terms of absence of knowledge.

The project manager's perspective on managing flexibility had been that "People who will be interested in upgrading the system will be the people who use it most - comes back to the original question of who the core group of stakeholders is who see themselves using the technology afterwards". This prompted the DSS leader to reiterate his earlier sentiments that more knowledge was needed of the decision-making environment because "how those stakeholders interact, use information and make decisions makes a huge difference to the sort of system we construct such as how the system is upgraded and who maintains it and flexibility". He suggested that a DSS advisory group made up of key highland stakeholders, akin to the Australian catchment management groups mentioned earlier, needed to be put in place in parallel with the conduct of the research project.

Biased access

The final topic of discussion concerned biased access to the information stemming from the DSS. In their questionnaires, each participant had suggested that the output of the DSS could be portrayed in different ways for different users. In the group discussion, I asked the sociocultural leader to try to identify some of the characteristics of a particular user which might influence the way in which the output would be presented to them. She raised literacy as one dimension: "there are some cultures who can't recognise a photograph as a 2D representation of a 3D thing. That's only been researched in Africa, but we need to be wary that what we put on the screen is going to be what people see". To manage this potential bias, she suggested trusted surrogates, such as NGOs, academics, or educated village youth, may need to be included in the suite of DSS communication media.

A second dimension raised by the sociocultural leader related to embedded bias:

> "There's the question of the way they see the world. I'm very interested in building that in, so instead of the public servants and ourselves thinking there is only one way of viewing the world and going at it in a Western way thinking that when you draw the land units onto a GIS there's only one way of seeing them... [One of the Thai social researchers] does lovely research on ethnographic land classification - how they classify land into different parcels. So steps like that would make it more user-friendly in being able to use their language and terminology - approaching their mindsets and classifications as we build it up."

This implies that the sociocultural leader had identified the risk of the nonreflective imposition of a Western approach to resource management, manifested in the physical DSS through the demarcation of particular spatial units, thereby undermining alternate constructions. She had also pointed out a potential means of managing this bias through incorporating within the DSS different modes of classification and description more consistent with alternate constructions.

As the discussion turned to communication of assumptions and uncertainties, the DSS leader introduced a value judgement confronting the researchers in regards to access:

> "Who has to have access to what level? Its the output of the system the stakeholders are interested in. I don't know if we're giving stakeholders access to underneath the surface of the system, where you are turning the buttons and pushing the levers. I think that will have to remain the domain of the technocrats.... Its unresolved what extent stakeholders need to or want to actually turn levers - or will they be happy having technical intermediaries who do that and just dealing with the output which is visualised in a way which they can understand?"

In the preceding quote, note how the DSS leader initially responds to his own question by asserting that stakeholders (which are framed as distinct from a technical bureaucrat) are only interested in "the output", implying that stakeholders would not be interested in the mechanics or reasoning underlying the output. As he continues reflecting on the issue, he becomes less sure, and shifts from focussing on the researcher's judgement ("if *we're* giving") to the stakeholders' needs and preferences.

Injecting a pragmatic voice, and emphasising a tension between ideal participation and project manageability, the project manager suggested that the issue could be displaced onto one of the Thai government departments:

> "Get the DLD to be the agency to say from the beginning 'we will take on the internal set-up, internal availability and track how its used'. And other people can also access it through the DLD. If we start off accepting all stakeholders have the same rights of access from the beginning, won't it go on for endless subcycles of different needs and demands?"

The sociocultural leader suggested that it was a technical inevitability that some information would be hidden from certain users, and that the fundamental issue was therefore one of trust: "will all the stakeholders trust the guardians and managers of the box? If people have confidence in what the managers are doing and what the output is saying, that's fine. If they distrust whoever's managing it and think its being used to put one over them...". The DSS leader then suggested that biased access could be managed through the proposed DSS advisory group:

> "Which is why establishing some group - a stakeholder advisory committee or steering committee which would have some ongoing involvement - that would build trust in the system so that at the end when you come to a high level interaction they would have some confidence, some understanding, some opportunity to look at what was underneath that surface layer."

Thus, a proposal to create a DSS advisory group initially arose as a possible body to take charge of and implement upgrades of the DSS in response to changes in the decision-making environment. It was subsequently framed as a means for the project to gain insight into the decision-making environment to assist the construction of a useable system, and finally, as portrayed above, was presented as a tool to engender trust and encourage skill-based learning in potential 'stakeholder' (i.e. non-technical) users.

It should be noted that as well as identifying biases in access, the sociocultural and DSS leaders both raised the potential for the DSS to improve stakeholders' access to decision-making. For example, the sociocultural leader remarked: "Any mode of communicating with stakeholders is woefully inadequate... If GIS can explain to people

better than verbal presentations or written workshops than anything else does, we can turn this into a real advantage". Thus, although her scepticism towards the DSS remains, the sociocultural leader is beginning to frame the DSS as an opportunity.

Managing biases

As protracted debate over access issues had run the discussion over its allotted time, the group asked to meet again briefly to summarise the biases that had been identified and to discuss actions the group could take towards managing these biases. This second group dialogue was held the following week.

In the previous session, the project leader had suggested that the possibility of a stakeholder advisory committee be raised at the upcoming joint team workshop. While the sociocultural leader agreed that the idea could be floated at the workshop, she warned that "it may be premature to be forming groups before we've got the other stakeholder process underway... It may be that that's not the best way to go and they may go leaping to fill all the positions and put people on a committee that we're nowhere near ready to having to meet (sic)". She commented that the team would need the first six months to design the visions process and that the ideas flowing from that exercise should inform the DSS process rather than vice versa. In light of the sociocultural leader's concerns, the group agreed that the most appropriate action would be to flag the issue at the workshop, but not initiate any further action, and instead debate the issue further as the project evolved.

When the discussion turned to issues of access, and in particular to the necessary trade-off between ideal participation and manageability, the DSS leader reiterated his support for the notion of a stakeholder advisory committee, commenting that he saw it as a reasonable compromise in terms of the participatory dilemma. In response, the sociocultural leader observed that the stakeholder advisory committee could be "stacked" to explicitly include representatives of groups that would normally be excluded from the process. Thus, the DSS advisory committee was framed as an empowerment opportunity.

The project leader then raised the issue of who ought to take responsibility for the stakeholder committee, suggesting that the Thais should take this role "since they've got to wear it", supported by the Australian sociocultural and DSS teams. Thus, not only project manageability but now also research ethics has been introduced as a reason to delegate responsibility for practice issues to the Thais.

In response, the DSS leader cautioned that a stakeholder committee was likely to be a new method of working for the Thais. Note that this raises a further ethical issue regarding the imposition, not of Australian-derived technology, but of participatory principles stemming from Australian conceptions of best management practice.

The group felt preliminary discussion at the joint team workshop would be the most appropriate action to take towards gaining a clearer idea of the decision-making processes the DSS would support, considering the flexibility of the DSS, prioritising information to be incorporated in the DSS, finding out which form of presentation of output would suit different user groups, and preparing a document outlining the assumptions, limitations and constraints of the DSS.

The discussion closed with the project leader suggesting that the issues raised through the application of my framework could be addressed during a short, dedicated DSS workshop in Thailand facilitated by myself, the DSS leader and the sociocultural leader. The DSS leader and sociocultural leader agreed, and a tentative date of mid-September was set for the workshop.

6.3.3 Postscript to Part B

In August 1997, shortly after the group discussion of Part B, the Australian project leader, sociocultural leader and project manager travelled to Chiang Mai for a joint team meeting. At this meeting, the Thai hydrologist was formally endorsed as the Thai DSS leader. The Australian DSS leader was unable to attend due to other professional commitments. In lieu of his participation, the Australian project leader outlined his own thoughts on the state of the DSS. He suggested that creating a single integrating DSS package during the first phase of the project would be overly ambitious, and that a better alternative would be to develop three separate but linked modules: a land use planning system such as LUPIS; a 'what-if' simulation program such as Extend; and a GIS database, Figure 6.3.

Given a tight schedule and an abundance of protocol activities, few of the issues which had emerged during the application of the bias framework were raised at the joint meeting. However, in lieu of discussion at the meeting, it was agreed that the Australian DSS and sociocultural leaders would travel to Chiang Mai in September 1997 to hold a workshop on the DSS component, focussing on how to integrate socioeconomic data into the DSS, how to ensure that stakeholders appreciated the capacity of the DSS, and how to prepare them to access and use the DSS. It was also planned that LUPIS and Extend would be demonstrated to the Thais at this time. It was intended that one of the outcomes of the workshop would be a conceptual diagram of how the three modules of the DSS would interrelate.

Upon her return from Chiang Mai, the sociocultural leader remarked that the visit had taken a load off her mind with regards to her earlier fear that the technicality of the DSS would dissuade active participation by the Thai sociocultural researchers and villagers:

> "I had had a mental image of the Thai social researchers having difficulties with the DSS, but [the Thai anthropologist] is right into ARCINFO and mapping from the village point of view. For example, there's a Karen village called Mae Lu which has been contesting land with the Forestry Department - some of the customary land boundary has been taken over by the Forestry Department for conservation forest. [The villagers] want to map their customary land uses in Mapinfo - some are interested in using the technology and others in having [the Thai anthropologist] do it and represent their interests. Mae Lu has an ethnobotanical centre where they've been collecting a community seed bank of species... They're interested in mapping this information too to map forest biodiversity... So the villagers are not seeing the DSS as a threat but as an opportunity".

Note that the DSS has been framed here in the context of spatial mapping technology, which represented only one module of the conceptual model of the IWRAM DSS presented at the joint team meeting.

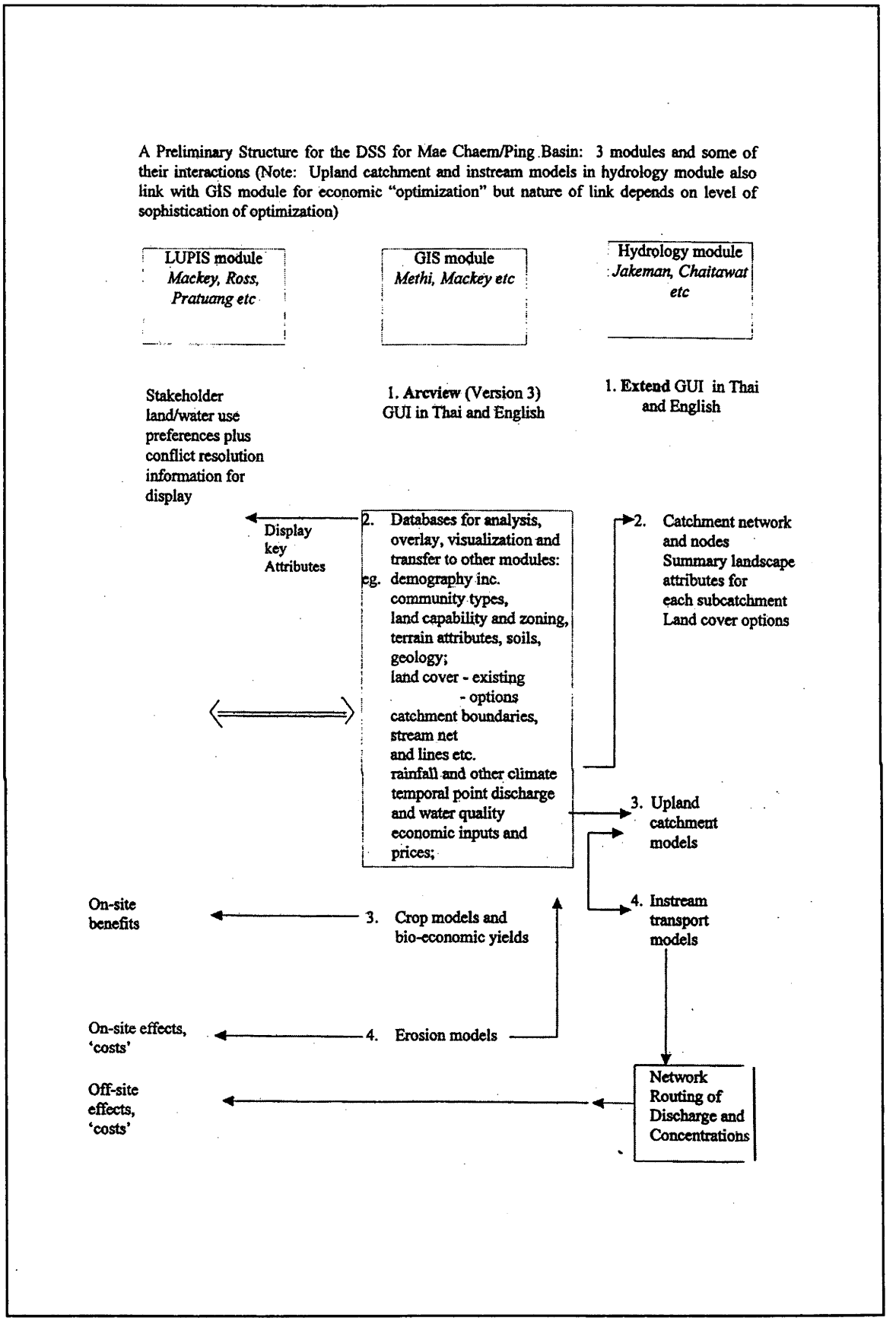

Figure 6-3 Framing the DSS: Australian project leader, August 1997

Due to conflicting professional commitments on the part of the Australian DSS leader, the DSS workshop proposed for September did not take place. However, the sociocultural leader did travel to Chiang Mai during that month. On her return, she filed a report in which she described further discussions she had initiated with the Thai sociocultural team on the DSS. Among the issues discussed was the potential to incorporate, within the DSS, villager perspectives on the landscape, such as Karen forest classifications and Mae Lu's records of forest biodiversity. The report also detailed the Thai sociocultural team's suggestions about the DSS. They proposed that the form and content of the DSS be considered in relation to three analytical scales: the local community or subcatchment; the catchment; and the policy level. They suggested that for each of these levels, there would be different needs, different players and different requirements for access to the DSS. For example, they suggested that it may be appropriate to have a computer based system at policy level, while 3D topographic models[33] may be a useful off-screen interface at the village level. The Thai sociocultural researchers also raised the issue of which Thai institutions would be appropriate to use and develop the DSS. They argued that in accordance with the new Thai constitution, "Thailand needs to create new resource management mechanisms, and the DSS needs this too". Options suggested were the new Tambon Administrative Organisations, watershed committees, or the community forestry network. They stressed that the Thai sociocultural leader, a member of the drafting committee for the new constitution, "would be very happy if our DSS demonstrated a mechanism for community rights in resource management". The comments of the Thai sociocultural team suggest that they had been construing the DSS as: firstly, a multilevel process necessarily engaging a complex and evolving political environment; and secondly, as a political opportunity to realise aspirations for social change which had thus far only been expressed abstractly within the new constitution.

6.3.4 Testing Part C: Biased access

I had intended to test Part C of the framework in early October. However, the participants felt it was too early to consider the explicit framework questions dealing with access, and that discussion should remain at a more conceptual level. In lieu of the trial of Part C, I interviewed the project leader and sociocultural leader about dimensions of access. The DSS leader was unavailable because of other professional commitments.

The project leader felt that the main problem regarding access was "the impediment the computer package itself presents to nontechnical stakeholders. It's a question of the form of info the DSS yields for those less technical users. The form - and also the availability, its distribution". Echoing his earlier sentiments regarding practice issues as the domain of the Thais, the project leader suggested that addressing less technical stakeholders' needs was primarily "a task for the Thai group with back-up from our side". None-the-less, the project leader felt that greater participation, equity and transparency for non-technical users could be engendered in the project through workshops and in the DSS through conflict management software:

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[33] The reference to '3D topographic models' relates to 3D cardboard models of the landscape, formed by cutting and gluing together contour shapes from 2D geographic maps. As discussed in Chapter 5, 3D models have been widely used within recent highland development projects.

> With the Lupis idea, we will be able to present spatial information on conflicts and alternatives - that will be suitable for certain non-technical users. The question is what do we need to do to address people who need something different to that, something more accessible and what it's going to cost to do that - I don't know that.

Note the introduction of a cost versus access tradeoff, suggesting that resource constraints may shape research outcomes.

The sociocultural leader proposed a resolution to the dilemma of the accessibility of the DSS to non-technical stakeholders by reframing the DSS:

> "The way I'm thinking is that we should concentrate on decision-making. People have always been making decisions. In the old days it was without computers - with files, asking other people... - a mixture of human and other sources. Its probably helpful if we see computer systems as that too. So the decisionmakers are more important than the tool, and we still need a mixture of human and recorded sources, and we look at the computer system as an elaboration of that. So the whole project is about decision-making, about helping in a process way and in an information way to make decisions. Therefore the DSS should be systemic - part of our process of providing information to them - part of the interpersonal, intergroup process".

Thus, the DSS, construed as a computer system, is framed as one dimension of a social decision-making process. The focus is placed explicitly on the decisionmakers, and in particular, on the information and processes they need to make decisions, rather than on the technology.

In contrast to the project leader, the sociocultural leader framed the consideration of access as a whole team responsibility with an important role for the combined sociocultural team as "volunteers and watchdogs to help it happen". In particular, she emphasised that dimensions of access, such as equity and participation, were a systemic component of the sociocultural research methodology, witnessed by:

> "...the extent to which the sociocultural team from the beginning is looking at how village perspectives and information can go into the DSS from the very beginning. Integrating 'what do we need to know for decision-making', and 'how can we collect and render it for the DSS' and 'what's in it for villagers to have a DSS' and 'what role would DSS play in their current conflict' - for example, having their own authoritative maps versus RFD puts them in a stronger position...".

Thus, strategies are identified which are aimed at realising an explicit political position in regard to the conduct of research, namely the empowerment of villagers.

Both the sociocultural and project leader felt that the major impediment to promoting access was resources. Noting a threat that the stakeholder workshops intended as part of the participatory framework would suffer from resource constraints, the sociocultural leader commented that "we're trying to do so much with so few people. Resources is the main threat to doability, not helped by the Thai budgetary crisis[34] - they're not well

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[34] Thailand began to experience an economic crisis in early 1997 largely as a result of rampant speculative real estate investment and bad lending practices on the part of Thai banks. By the time of these interviews, the gravity of the economic situation in Thailand was becoming apparent, as budgetary difficulties increasingly constrained the capacity of Thai collaborators to fund their research within the IWRAM project.

endowed either". The project leader also raised budget as an issue, together with time and stakeholder (in)flexibility:

> Constraints - immovable if we have narrow minded stakeholders - the constraint is the flexibility of individual stakeholders. Budget and time constraints to produce process based models and to do the economic and social surveys - we don't have a project without those. I'm not saying that participation, equity and transparency are second order issues - they'll obviously embellish the project considerably and its utility. But if we don't do the core modelling which provides the what-if tool, we're not underpinning things.

Thus, participation, equity and transparency are cast as embellishments, while the modelling and scenario components of the DSS are framed as the foundations of the project. The quote also implies a focus on the tangible products (models, surveys) that are perceived to drive the project, evidencing the evolving contrast with the sociocultural leader's emphasis on decision-making and interpersonal processes.

By the conclusion of the access interviews, two distinct and divergent modes of construing DSS had emerged which provided a key tension during this phase of the DSS development process. One mode framed the DSS as a sophisticated, transferable, software-based product and research tool. This mode tended to regard practice issues as largely beyond the domain of the project, and consequently was less interested in integrating strategies to minimise potential biases in access into the DSS development process. A second perspective construed the IWRAM project as aimed at supporting the process of highland environmental decision-making. Within this mode, the DSS was framed as one element out of a suite of supporting processes and information. Due to its practice focus, this mode paid greater attention to identifying means of managing both embedded bias and potential biases in access.

6.4 The analytical framework and the Thai team

Given that the proposed DSS workshop had not eventuated in September as planned, and my efforts to test the framework with the Thais via email had been unsuccessful[35], the Australian team suggested that I travel to Thailand and test the framework in person, and subsequently convene a DSS workshop. I tested the whole framework with eight of the Thai IWRAM researchers during October and November 1997[36]. Other researchers deferred to the opinions of component or project leaders, and the Thai sociocultural leader seconded his junior associate to participate in his place.

6.4.1 How will the DSS be used by whom?

Most participants identified government policymakers and technical staff as the most likely direct[37] users of the DSS, but also felt that all stakeholders (where 'stakeholders'

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[35] Reasons for the lack of success in using email as the medium with which to communicate with the Thai researchers are detailed in my methodology, Chapter 2: Section 2.4.3.

[36] Note that some of the labels used to identify the different Thai participants (such as 'project manager' or 'project leader') are identical to the Australian participants' labels. Within this section, all such labels refer to the Thai researchers. In the following section, where the Australian and Thai teams interact, the labels are prefaced by 'Thai' or 'Australian' to avoid ambiguity.

[37] Note that the terminology 'direct users' referred to people who would interact (query, validate, feedback) directly with the DSS, in contrast to 'indirect users' who would interact with the information output of the DSS via a mediating interface. This terminology was negotiated with the Thai researchers.

usually referred to different government departments, villagers, NGOs and academics) should be users of the DSS, at least indirectly. Only one participant, the biophysical leader, did not identify villagers as a potential user group. He felt that the primary aim of the DSS was to show government staff, researchers and some NGOs what was the best solution for the basin. This researcher also felt that the key advantage in having a DSS was to provide researchers and government staff with greater authority and credibility to tell the villagers to change their land use practices:

> "Sometimes we want the villagers to change from their old cultivation to a new system but it's hard to tell them. I think that if we have the DSS we can show them what will improve their standard of living. If it is easy enough for villagers to see, it will help us to have them believe us. If we can have a nice colour monitor and they can see a nice 3D model on the computer screen, it can help them to trust us, to believe what we will say".

This statement may be interpreted in two alternate ways. On the one hand, a communicative motive may be the central issue, with the researcher concerned about enhancing trust and transparency in communicative interaction. On the other hand, it may be inferred that this researcher perceives villagers to be ignorant about what is best for them, and also that he is more concerned that expert suggestions are implemented than he is in promoting greater understanding by villagers. Also note that while this researcher envisages the villagers seeing the computer screen, he does not frame them as active users, implying that he construes them as passive recipients of the information.

Of the rest who had identified villagers as potential users, many felt that the DSS would allow the villagers to understand better both the state of the environment and the impact of their current practices. Others suggested that the DSS would allow villagers to evaluate biophysical processes, undertake sustainable development or better protect the environment. The project manager suggested that if the villagers were able use the DSS to explore the best development options, they could assume responsibility for this task in place of government officials: "If they understand what they should do, no need for government officials to help them". Thus, the DSS is cast as a means of decentralising decision-making.

The GIS researcher noted the potential for villagers' use of the DSS to assist conflict resolution:

> Maybe we can use the DSS to reduce conflicts between highlands and lowlands. Because normally people on the highlands use a lot of fertilisers and pesticides and it affects people in the lowlands - the residues flow to the downstream. If the people in the highlands know this and reduce, it will resolve problems.

Thus, conflict resolution is cast not as an interpersonal negotiation, but in terms of overcoming the ignorance of one of the parties. The quote also implies that if highlanders became aware that their actions were causing harm downstream, they would change their behaviour; an analysis which seems to neglect the complex network of psycho-sociocultural pressures confronting villagers and shaping their decision-making.

The anthropologist also highlighted conflict resolution, emphasising the potential for the villagers to use the DSS to level the negotiation playing field:

> The power to bargain now is not equal, because villagers can't access the scientific information... Some of the villagers want to learn about GIS - if we can transfer the technology to the village to understand it that will be

> good. One time, the RFD[38] wants to calculate the land for cultivation for the villages. The village bargains with RFD that when they evaluate, they walk around and evaluate. But RFD wants to use the new technology. The RFD official goes to the land cultivation of the Karen ethnic and reads the satellite from one point and calculates everything. After that, the villagers wanted RICOP - a NGO- to teach them the method of how to read GPS[39]. RICOP teaches them that they need 5 points to evaluate - but the RFD only uses one point. So, maybe the RFD were wrong. This gives the villagers bargaining power. If the villagers have the same technology as the government, they can argue - because the RFD won't "walk around" which is what the villagers usually do.

This suggests that some villagers may feel that they have been duped in the past by the imposition of a technological approach unfamilar to them. It also suggests that villagers have recognised that if a more powerful stakeholder will not adopt village practices, such as walking around an area to demarcate land, then they must empower themselves by learning the other stakeholder's practices.

All but two of the other participants also raised the potential for the DSS to assist negotiation or conflict resolution, but in more generic terms. For example, in a similar vein to the anthropologist's sentiments, the economist thought that the main benefits to different users would be conflict resolution through standardising information access:

> "People will get better agreement - it will reconcile the conflicts because people will get the same information. Otherwise the people think the decisionmakers just make the decisions for them. At least the village leaders can - they can persuade the rest".

Note the inference that people will feel more involved in decision-making if they are receiving the same information as decisionmakers. Also note the distinction drawn between 'the people' and 'the decisionmakers', suggesting that presently, the general populace do not play an active part in decision-making.

The DSS leader suggested that the key benefit that users of the DSS would acquire would be scientific credibility for their position:

> "They will have scientific proof of their preference for resource management. If its negative - no proof - I think they will lose their ground in the hearing - but they will know why they have to step back. If the system works, then the authorities will be able to deal with the people on the basis of scientific proof, not because they have the power of law. Scientific proof is not a solution - I see it as a thing that makes equity...

In the preceding quote, the DSS leader proposes that scientific proof should provide the basis for resource management decisions, and assumes that the DSS will be capable of providing definitive scientific proof of the benefits and costs of one preference over another. Thus, the DSS is framed as an expert arbiter. It is implied that the DSS leader believes that resource users whose practices are unsustainable will be more inclined to alter their behaviour if scientific proof of unsustainability is given than if the law is relied upon. However, an alternate interpretation could be that the DSS leader believes

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[38] RFD refers to the Royal Forest Department.

[39] GPS refers to Global Positioning System, a hand-held device which relates the position of the device through reference to satellites.

that authorities sometimes impose decisions which are grounded in law but which may be scientifically suspect.

The OHD director saw the potential for the DSS to promote political harmony by helping to identify an ecologically sustainable land use pattern that would allow the highland people to remain in the highlands rather than be forced to relocate in the lowlands: "We have to live together. We can't bring the highland to the lowland. We have to be happy". In this context, he emphasised the role for DSS in assisting government staff in land classification and zoning through identifying development options.

Two other participants, the project manager and the project leader, also felt that the DSS should propose development options for the highlands. The project manager suggested the DSS should provide an integrated evaluation of different development options:

> "In Wat Jan in Mae Chaem, it is mountainous with pine trees, villagers is Karen. In the Philippines, I see a place like this which they develop as a recreation area. Maybe you can do this in Wat Jan - ecotourism say, because the weather is good and pine smells good. But the FIO[40] wants to cut down the trees. Once we study the biophysical, economic and social, we will find out the best result. Cutting trees may be best economically, but not the best result. DSS should give the decision what we should do on Wat Jan. So DSS should come up with options and leave it to the ones who is going to manage the area to decide... The FIO think you should cut down trees according to sustainable yields. But the conservationist people will always say no. And the Karen don't want to cut trees... I agree with Karen and conservationists. We can make profit from land, soil and tree by not cutting trees - by having resort we will not have to lose scenery".

According to this approach, options would be proposed by different stakeholders, the DSS would provide a biophysical, economic and social evaluation of different options, and then the decisionmakers would make a decision informed, but not dictated, by this assessment.

The project leader favoured an alternate, formulaic approach, whereby the DSS would propose suitable development options for a particular parcel of land depending on how it fared in terms of different biophysical and social criteria:

> "Decision support - they could draw factors towards development - could give an idea to the decisionmakers or practitioners of development to use the data wisely in proportion. For example, if the biophysical come up with for a particular village, the soil is medium, they have ample water for upland crops only, and say what could be the field crop, and with that land and available water, which family could live there. That could be a basic to scale up. They should give some indication why this land is good for this etc., and when they come to people, the social team will come up with beliefs, way of living, how people work".

All participants mentioned that development of the DSS would be useful in acquiring, organising and coordinating data into a central information or data system. Focussing on the potential utility of the DSS for his staff, the OHD Director recalled that one of their original motivations for initiating the project had been to better coordinate the

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[40] FIO refers to the Forestry Industry Organisation, a state enterprise within the Ministry of Agriculture and Co-operatives.

mass of data relevant to highland zoning but scattered within a variety of different government departments: "We have a lot of data - DLD, RID, EGAT[41] - so [the OHD hydrologist] thinking how to put this together". Similarly, but in reference to a wider group of users, the project manager commented: "We work on the highlands for 15-20 years, but data is scattered all around. If it is all in one system, it will help". The economist and the biophysical leader both felt that a main purpose of the DSS should be to provide a quality database. However, it should be noted that they were the only participants who described the acquisition of information as a key purpose of the DSS; generally, it was cast as a welcome but incidental function.

Recognising the limitations of fragmented approaches, the project leader felt a key advantage of the DSS would be its capacity to integrate data and analyses:

> "If I was a planner, and took only the biophysical data, I would be lost - I would have forgotten the people. The biophysical don't have a full idea about investment - don't know how much it will cost you to grow crops. The economic needs to look at alternatives of crops - whether you should start with rice or corn or vegetable. At the moment there are many papers on rural development, how to invest. But they try one by one. It has not been co-ordinated. If I was a plant science (sic), I only think of plant - forget about animals - don't have the total picture of development. That's where the DSS will be helpful".

Due to the information processing and integrative capabilities of the DSS, both the OHD director and the DSS leader (also from the OHD) felt that the DSS would be directly useful to OHD staff both to improve efficiency and to allow a greater range of factors to be considered. In terms of efficiency, the OHD director remarked that "computer technology will mean that we can do a better job and will save our time, than doing by hand... no need to do things that other people do already". This quote seems to refer to two characteristics of contemporary Thai bureaucracy: firstly, the lower computerisation levels, and thus increased reliance on manual techniques, compared with Western bureaucracy; and secondly, the tendency for duplication within and across different Thai government agencies.

In reference to the perceived advantage of the DSS in allowing consideration of more factors, the DSS leader explained that:

> "The major advantage is that if things go as I plan, we can have a complex computer system that will help the resource planner to analyse the scenarios without the resource planner needing to become a [computer] expert. In past every planner knows there are many factors they have to skip because of resource constraints. Also, they needed to be a computer expert. So if we develop a system which is simple enough for those people to use without computer expertise, that is a big advantage".

Thus, the DSS leader had framed the DSS as potentially fulfilling an expertise function, and had articulated a hope that the DSS would be sufficiently user-friendly for people with low to moderate computer literacy to use the system, thereby signalling a desired characteristic of the form.

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[41] Department of Land Development, Royal Irrigation Department, Electricity Generation Authority of Thailand

6.4.2 Who should develop the DSS?

In response to a question about who should be involved in development of the DSS, two different perspectives emerged. One group of participants suggested that the project researchers should provide relevant data and analyses, guided by the priorities and demands of the government users. Exemplifying the sentiments of this group, the biophysical leader explained:

> "The biophysical have to contribute information about pattern of land use, available water etc. For social - they should contribute data about what is the main activity/cultivation pattern for each specific tribe - where their income generation come from and their willingness to change to new ideas - what would be a good approach to go talk to them... The economists should find out when we have a crop pattern, what is the income they will earn for each crop pattern. - their net income... I feel that the project has to ask the users - the RPF, DLD - what they want for the DSS, what the goal is - after that we can decide the data gathering system".

Within this perspective, stakeholder involvement in DSS development was limited to (one-way) provision of information, as opposed to active, reflexive engagement. For example, the economist argued that the mechanism to involve stakeholders in development of the DSS was already being implemented in the project through the collection of different stakeholders' visions and options:

> "I think they are already incorporated in each component - through their visions, their options. In the economics component, we plan to build the existing pattern and then ask what pattern they would hope for, and the customs and traditions we already put them in the model. If you use input from these components, it is already incorporated. So, we ask them about traditional agriculture, if they have to raise some animal for their religious traditions, if they need rice for consumption, we'll have them as constraints in the model. Even if another crop is more profitable, we'll still put the rice as a constraint in the model".

It is worthwhile noting that this mode of stakeholder involvement was seen by proponents of this perspective to promote increased stakeholder participation in decision-making. For instance, the biophysical leader argued that the DSS would increase participation because "when you design the DSS, you have to collect data from the stakeholders and it makes them aware of what you are doing". Meanwhile, the economist felt that the DSS would increase the participation of stakeholders "because if we have the stakeholders views taken into account in the model, then when the decisionmakers use the model as inputs to make decisions, it is already there". So long as their views were built into the model, and were updated from time to time, she thought it was unlikely that the DSS would decrease the participation of any stakeholders in environmental decision-making.

The second group felt that a range of stakeholder representatives, not just government officials, should be more actively involved in DSS development, although perhaps indirectly. For example, the DSS leader suggested that NGOs, officials, business representatives and villagers should all be consulted from the beginning of development about what they would want from the DSS, probably through an intermediary from the social team. Perceiving the social team to have better communication skills, he explained that "I will not deal with stakeholders directly, but through [the Thai anthropologist] - it will be up to him to reflect and express villagers' attitudes".

Introducing the notion of socially embedded bias, the project manager suggested a more direct mode of stakeholder involvement in DSS development:

> "We should have a meeting and share opinions once we have the data - the RFD may see data from one point of view, the DLD from another point of view. For example, my background is forestry - I may think a particular area is suitable forestry, others may want vegetables. Or RID who are used to big projects may not see a particular area as suitable for irrigation, but [the OHD] office are used to small-scale irrigation, so may think its OK. They all have different backgrounds so that's why they have different points of view. And tribes too. We should have a meeting with the villagers there especially - they need to be involved from the beginning. So we know from the beginning why they not accept some things".

When discussing the topic of who should be involved in DSS development, the anthropologist raised two tensions in the way that the project was presently undertaking development of the DSS. Firstly, he recognised that stakeholders had not yet played a role in the development process: "Stakeholders should be part of the DSS development, but at the moment in this project, its only the researchers. The characteristics of the DSS should be suitable for the highland environment and its people". Secondly, the anthropologist queried the identity of the researchers who had been involved in the development process thus far: "I think the DSS team have to have all components included - biophysical, social DSS. At the moment, the problem is that the team is only biophysical". Implicit in the anthropologist's perspective was a distinction between the provision of data and analyses to be incorporated in the DSS, and direct participation in the conceptual development of the DSS. The anthropologist had observed that within the current mode of DSS development, stakeholders were involved through providing data on themselves and their land to the social team, and the social team was involved through providing this data and analyses to the DSS team, but neither group were actively contributing to framing the content or form of the DSS. Note also that the earlier quote suggests a link has been drawn between active participation of highland people in DSS development and the likely relevance of the DSS to the highland decision-making environment.

The only other participant to draw a similar distinction was the DSS leader, who differentiated between researchers who would "contribute their work to the DSS and will help to set up the database" and researchers who would be "directly involved in developing the DSS - computer experts".

6.4.3 Anticipating embedded biases

The project leader, project manager and economist each raised the difficulties in acquiring accurate interview data as a potential source of uncertainty with bias implications for the DSS content. The economist remarked that "when we do surveys - the data we get we can't rely on for sure... even when we speak the same language, when we double check the data, it doesn't add up". These sentiments were echoed by the project manager who implied that some villagers deliberately distorted their economic worth when interviewed: "Its not easy to get true income figures. For example, when you see the Hmong - they have 4WD, quite rich - but they don't give you the real figure. For production data, you need to systematically monitor to get true figures - interviewing may not give true figures". Meanwhile, the project leader

suggested that data disparities were due to the ignorance of villagers as to scientific measures:

> "Instead of just asking farmers how much yield he gets, you should do a real trial so you get the data with your own eye. With research before, we have proved that just asking farmers for the data is useless - they do not understand the units we use. For example, they do not understand 1 kg - they understand 1 bundle instead. So you shouldn't just interview, you should stay there for a season and observe to see with your own eye".

Two alternate communicative interpretations emerge. One possible inference is that farmers are unreliable research informants, and that to manage distortions, researchers should conduct their own experiments and observations as triangulation for interviews. Alternately, the inference may be that survey instruments are unreliable because of difficulties in asking yield questions in terms the farmers are familiar with.

The biophysical leader suggested that uncertainties would mainly derive from the economic component, both because the economics model would not incorporate all significant factors and because of the dynamic nature of the decision-making environment:

> "I think problems for uncertainties come from the economics model - when we think about the price, we haven't thought about the transportation cost. There are many middlemen who get highland products and they put the price lower than the standard. And they have a trend that if a particular product is successful one year, every farmer will change to that crop the next year. So it will fluctuate much more then biophysical data... You need to make corrections about the economic model - more crop varieties, changes in labour... From the beginning, you need to have in mind how to update the decision methodology".

He also worried that the sociocultural component would introduce bias because their research would not capture enough different hill tribes to be representative: "They should do at least five tribes, maybe"[42]. Finally, he raised the choice of biophysical models as a possible source of bias, although he was confident that this bias would improve over time:

> "Uncertainties will be about the decision - which model to use. When you do, for example, rainfall-runoff modeling you will provide different results when you calibrate the model. And in the future, when you have more data, the model will improve in the long-term. Assumptions are about rainfall patterns, effects of terrain on water availability".

The biophysical leader's concerns about inadequate representativeness and the capability of the models in the DSS to cope with a changing decision-making environment were echoed by the economist:

> "I don't know for the modelling, if we do optimisation, I don't know if that optimisation is real because we can't incorporate everything in the model... If we try to use optimisation and we try to incorporate constraints, we may not be able to find those figures or even find the relationships. For example, if we want sedimentation constraint, we may not have that figure... [And] we have to assume homogeneous, but on highlands, we have many types of farmers and I don't think the model represents that...

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[42] The subcatchments chosen had only two tribes strongly represented, and a small population of a third tribe.

> And from the model we plan to use, we will rely on just one year's data, from the interviews. At the moment, we don't consider the time trend. And the situation may change for example if they do mining in the highlands, they may run out of minerals and stop - or if some tourism starts, or if there are crops in the future that are more profitable that we didn't consider when we built the model, and population, migration, climatic things may change."

To manage these potential biases, she suggested comparing a range of models and undertaking sensitivity analysis.

The anthropologist raised a potential bias in terms of absence of knowledge if only information from a single discipline was incorporated in the DSS, or if only information derived from scientists was incorporated in the DSS, excluding pertinent local knowledge:

> "If policymakers have one way or idea, if they get information only biophysical or only social, this leads to misunderstandings in constructing policy for highlands. I'm interested in the DSS if the DSS should have many, many information including social, biophysical and economic and opinions of the villagers, of the stakeholders".

To illustrate how a villager's perspective may diverge from a scientist's, the anthropologist described how villagers had explained to him why they disagreed with scientific advice about pest control:

> "I believe in both science and the position of the people to construct information... The science cannot know everything about the environment, the villagers have knowledge about dealing with the environment in forest and land and water - their environment is part of their culture. In the past two or three days, I went to Mae Chaem. I interview the villagers who are growing rice with shifting cultivation and animals - ask them about different methods they use. They use the method to share the benefit between humans and animals to protect rice - in the ricefield, they have many bird to eat their rice. He argued with new green revolution method proposed by the government to use gun or net to kill birds to increase economic profit. He thought it was wrong. The birds just eat some rice - man and birds can live together".

Thus, the assumption by government scientists of the mutual exclusivity of birds and maximum economic profit is contrasted with a symbiotic construing of man and nature. Note that this particular government strategy shares similarities with the broader government contention that Thailand's ecological and economic security would be enhanced if villagers were removed from the highlands.

The project manager emphasised the potential for socially embedded bias in terms of variables considered in option analysis:

> "If I am a forester - the forest is mine - I should do whatever I want to do to develop forestry fully - I should use all factors I can to develop forests - but not think of others. This used to be the story of past development - the intermix between factors has not been there - they only think of forests. I think of myself - not of you - this is the bias. For successful development, you need full knowledge of factors".

The preceding quote alludes to the history of contentious and fragmented decision-making in the highlands, and implies an embracing of an integrated approach in terms of both holistic analysis and equitable decision-making.

Also highlighting the potential for socially embedded bias, the DSS leader cautioned that the people directly involved in development of the DSS "are technocrat people so their ideas and perceptions will affect the output heavily. Because the people in the social group will have less participation in the system, I think their preferences will be less expressed in the system". When asked to elaborate as to how technocrat ideas would influence the DSS, he responded that the DSS would most likely end up as "something very rigid according to the theory or the quantitative modelling; input to output".

6.4.4 Anticipating biases in access

Literacy and other communication biases

The topic of potential biases in access was dominated by discussion about literacy and communication constraints, which in turn was dominated by the issue of how to present the DSS output to villagers with limited traditional, computer or scientific literacy. For example, the DSS leader commented that:

> "We are going to use [the DSS] in a forum for debating, so it should be a map and some sort of presentation so that everybody can understand the result without being literate. And we need some sort of academic report for officials as well, but I don't think that will be a major concern. But the way the result will be presented to uneducated villagers is the major thing... Earlier, I thought we would try to have as many people as possible access the [computer] system - but then I decided it wouldn't work - the information is too complicated. So, instead, we should have a trustworthy organisation that would provide the information to the forum."

Thus, the DSS leader had identified (il)literacy as a key factor constraining access to the information output of the DSS. It may be inferred that the DSS leader has distinguished equal access, whereby everyone would be provided access to the computer system, from equitable access, whereby everyone would be entitled to receive and understand the information output of the DSS. To manage literacy constraints, he proposes that the information output of the DSS be communicated to the stakeholder debating forum via an unspecified trustworthy organisation. Thus, limits to transparency (because the information is perceived as too complicated for villagers to understand) are dealt with through enhancing trust.

The DSS leader went on to explain that concerns about this issue had prompted him to ask a building and design architect friend for advice on how the DSS output could be presented in different ways:

> "That is the main reason that I try to employ my architect friend - he says that there are many ways you can present information to different levels of people - executives, politicians, scientists, villagers. Everyone will need different levels of presentation. Firstly, if the target is illiterate, how do we present the information. Secondly, if the target is very educated but from different fields, for example, businessman, scientist - how do we present output?"

This implies that the DSS leader construed that different policy communities would be familiar with different modes of presentation of information. Thus, biases in access would not be limited to the illiteracy of villagers, and a communication strategy would

be required to enable the project to provide each policy community with information in an appropriate form.

The anthropologist also highlighted the need for different communication media to suit different stakeholders:

> "The main objective is to communicate - need to have many ways to communicate. For villagers who don't use computers and find it hard to read, topographic models are useful to explain things - better than computers. For the academic, computers are OK. Posters to explain the way for land use or models to explain the way to control land use is OK for some villages... The information from the village level needs to be the same as the information that the academics have so they talk the same language - but the instruments of communication should be different... We have to accept that many stakeholders have different education and need different ways to communicate. In my office, we have the same problem - I can use MAPINFO, another person cannot use it and it is difficult to communicate".

In addition to conventional literacy constraints, the anthropologist raised the issue of how science could be communicated to villagers with limited scientific literacy:

> "Indirect users have difficulty with computer, scientific literacy. When they construct policy, the policymakers refer to scientific information - the biophysical data on the water - the villagers don't understand how it changes, why it happened. For example, the policymakers blame the villagers slash and burn for sending carbon dioxide into the air for greenhouse. The villagers don't understand how this happens. So, I think it may be difficult to communicate science to the villagers. I have a question - can we construct science that is easy to understand - possible or impossible?"

Like the anthropologist, the GIS researcher supported the use of topographic models and posters to communicate with villagers, as well as digital and analog products from the DSS for the other users. Similarly, the biophysical leader commented that "I think it should be presented graphically because for the stakeholders, people who can't read or write very well, the graphic view will be easier to understand. And it should be in table form for researchers".

In relation to the need to communicate assumptions and uncertainties, the biophysical leader recognised the limitations of the DSS in terms of accuracy of both analyses and predictions of impacts, and suggested that this needed to be communicated to users (who he had framed as government officers and researchers). However, he felt that communicating assumptions and uncertainties to stakeholders (who he construed as villagers) would be difficult:

> "We have to tell them that this is a mathematical model - it can't give you 100% success. The users can understand but for the stakeholders it is more difficult. But I think if you show the stakeholders fancy graphic output, they won't question it. I think the farmers in Thailand are trained to believe that if you do a lot of study and if you have good communication with them, they tend to believe more what the government tells them and what the academic tells them than do more educated people".

Note that this researcher does not consider the possibility of alternate modes of communication of the DSS output which might lead to deeper understanding by the stakeholders. Instead, he presupposes the imposition of a system suited to the educated

users onto the uneducated stakeholders. This quote suggests that it is preferable if villagers do not question the output of the system, and that 'fancy graphic output' will ensure compliance. Indeed, the perceived ignorance and naivety of villagers are viewed as means to overcome embedded bias.

In contrast, the economist suggested that a human intermediary may be useful to communicate uncertainties and assumptions associated with the DSS to villagers:

> "We might need say extension workers to advise them. And if they change the policy, we need some extension worker to educate them - or even better, maybe some educated village leader or someone else in the village - that would be better than the external person. I really want them to be educated somehow - that would be good for the village."

Note that a hope has been articulated for future empowerment of villagers, and that empowerment has been linked to the villagers receiving education about the DSS output.

With regard to the literacy constraints of other users, such as policymakers, the biophysical leader, the GIS researcher and the economist all emphasised that the DSS should be in Thai. As the biophysical leader explained:

> "I think in the beginning the system can be in English, but in the long run, you have to have the Thai version because people are getting used to, for example, the Microsoft Thai version - they get used to that. And its good for reports - they have to submit reports in Thai."

The anthropologist suggested that to assist policymakers to comprehend the information output of the DSS, the output should have both tabulated, quantitative and descriptive, qualitative components:

> "The information - in the past, the policymakers usually use database - many, many tables; many, many numbered records. The table records are sometimes misinterpreted if they don't have a description under the table. So should have both data and description. For example, soil erosion - if we read information from the table, we have the number of soil loss, sedimentation and know the cost of soil loss and sedimentation. We usually assume soil loss come from shifting cultivation, agriculture. If we explain as description, the activities of the stakeholders who do soil loss on some catchment and the historical record of soil loss and their activities - this description is useful for decisions."

This implies that the anthropologist has observed or experienced problems when policymakers rely solely on tabulated, quantitative information. It may be inferred that incorrect assumptions are made about the quantitative information, and that the inclusion of qualitative descriptions is seen as a means of managing this absence or distortion in knowledge.

Biases in geographical access

The biophysical leader felt that geographic access was unlikely to present a problem to potential users since "if the user knows we have it they will come and find it". In contrast, the anthropologist suggested that geographical access may prove a significant constraint and thus the geographic location of the system should be flexible. Reasoning that geographical access may pose difficulties for remote users, the GIS researcher suggested that the DSS package should be accessible at a range of locations,:

> "If you want the villagers to use the DSS - they don't want to travel a long way to use the DSS. Even if the system is in one place in Chiang Mai - other people in Chiang Mai may have problem - we have to think about time dimension too - they may be too busy to go to another office".

The DSS leader also felt that highland villagers may have difficulty accessing the information output of the DSS because of the geographical location of the DSS. However, he felt that:

> "Villager accessibility to DSS information is not crucial. For example, soil map, geologic map they won't mind or even be interested in. What they are interested in is government policy imposed on their resource and the development scheme. And I think that information can be distributed in many ways... We are dealing with people in remote areas. It will be the job of the people who organise the forum to take out the information to those people and bring back their preferences to the direct user".

Note the initial assumption that villagers would not be interested in the information output of the DSS, only the (second-hand) implications of the analyses for their resource use and development. None-the-less, he views geographical access as a problem that may be surmounted via human intermediaries.

Biases in financial access

The anthropologist felt that both government and other stakeholders should bear the costs of establishing and maintaining the DSS. However, the biophysical leader and GIS researcher both felt that requiring users to contribute to the financial cost of the system would be prohibitive[43]. As the biophysical leader commented, " I don't think they would pay to use it - it would have to be free". The GIS researcher suggested that to minimise costs it would be necessary for the DSS to be PC-based rather than UNIX-based.

To overcome financial access constraints, the project manager suggested that use of the DSS should be free to all stakeholders except business:

> "I think we should give it free of charge so everyone can use. But if a company comes, maybe they should be charged. The owners should be the Royal Project and the A.N.U. In the North-East part, there is some area in the highlands which is a plateau. Some places is not reserve because its not hilly and mountainous, but is flat land. But same conditions as Northern highlands. So maybe the companies would want to have this knowledge of the DSS. If so, they should pay because they make profit".

Note that the DSS has been framed as a transferable tool, a function often emphasised during the Australian application but only mentioned in this instance during the Thai application.

The DSS leader stated that he was certain that indirect users, such as villagers, would not have to pay, thus financial access would not pose difficulties to them accessing the information output of the DSS. However, he also felt that potential direct users may

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[43] When reviewing this narrative, six months after the interviews had taken place, and with the Thai economic crisis deepening, the GIS researcher commented that she now advocated requesting a service charge from rich users such as private companies and foreign research organisations, rather than providing free access for all.

face difficulties because of the financial cost of the system, particularly given Thailand's economic crisis:

> "Probably, the financial cost because we had an economic drawback now - last year I would have said 'no'. Right now, every agency in Thailand has financial difficulty, so whoever will be the user will face some difficulty [maintaining the system]...".

Biases and political participation

Within a framing of the DSS as an expert arbiter, the DSS leader suggested that stakeholders' participation would be enhanced because they would be more informed:

> "Their participation should be greater than now because, right now, they debate on something that they don't know for sure if it is right or wrong - they just imagine. If they have a scientific case, they will have something that will back them up in the negotiation process. [Now] everyone can contradict everyone else because there is no scientific information that will back anyone up".

The inference is that conflicts are currently difficult to resolve equitably because of a lack of clarity regarding the validity of the different arguments. Equity is thus linked to authority and credibility in negotiation.

The DSS leader also foresaw the potential for the introduction of the DSS to decrease the participation of stakeholders whose preferences were not supported by the DSS:

> In the past, there are a few groups who focus on short term benefits from exploitation - I expect their participation will decrease because surely they will lose their benefits in the process because now we are focusing on sustainability.

The preceding quote implies that sustainability has not been pivotal in existing decision-making processes, and that the introduction of the DSS will raise sustainability to the fore.

Taking a delegated power and citizen control stance on participation, the anthropologist argued that:

> If the concept of DSS is wide and covers mechanisms and information, it will increase participation because it will decentralise access to information and access to construct policymaking. If the concept of DSS is just software, just for policymakers, it will decrease participation of the people who cannot use the software.

Note in the preceding quote how different modes of construing the DSS have been linked to different implications for participation.

When asked whether she thought the DSS might decrease the participation of any stakeholders in environmental decision-making, the GIS researcher responded:

> Maybe - because they have something to help them, so they don't use their brain. If they don't have DSS, they make the decision themselves. Not the villagers, I mean the headman or district officers - some of the government people, me, even. I assume the DSS will be better. So, if people are going to rely on DSS, its important to have good information in it - verified information.

In the early part of the preceding quote, the GIS researcher identifies the risk of unreflective adherence to the technocratic solution. The latter part of the quote suggests that such a situation is acceptable if the information embodied within the DSS is verified.

6.4.5 Thai group discussion of biases

As the preceding sections have illustrated, the individual interviews with the Thai project team yielded a range different perspectives as to who should use the DSS and how, and who should be involved in developing the DSS. Interviewees had also identified numerous potential biases associated with the DSS, particularly flexibility and communication issues.

In November 1997, the Thai project manager, DSS leader, GIS researcher, anthropologist and myself met to discuss issues which had arisen during the interviews[44]. Other interviewees who were unable to attend asked me to communicate their perspectives. The discussion opened with the topic of users. The participants were asked to identify all potential direct and indirect users. The participants agreed that at this stage, the targeted direct users should be the Royal Forestry Department (RFD) and the Department of Land Development (DLD). Targeted indirect users were identified as the Tambon Administrative Organisations (TAO), some NGOs and a media organisation called THAI-VIF. The media organisation was identified in recognition of the impact that the media's reporting of highland environmental issues and conflicts may have on the politics and process of highland environmental management. There remained divergence as to whether villagers should be explicitly identified as users. The anthropologist and project manager felt that this was possible, but the DSS leader preferred to deal with villagers through the TAOs. The participants agreed at this stage to take the latter approach, but to revise their strategy as the DSS developed.

In terms of possible mechanisms to engage users in the process of DSS development, the project manager, an RFD officer, volunteered to initiate communication with a representative of the RFD. The DSS leader described how he had already initiated communication with a member of the Land Use Planning Office of the DLD. The anthropologist nominated the social team to communicate with a relevant TAO, some NGOS, and the media organisation.

It was agreed by the participants that the DSS should be a part of the participatory framework. It was also agreed that as the form of the participatory framework developed, the sociocultural and DSS teams would interact more closely about how the DSS should relate to the framework, particularly how information should be disseminated and to whom, how the DSS could be flexible to users' needs, and feedback mechanisms.

In relation to the embedded bias and biased access issues which had been raised in the interviews, opportunities to make the DSS more accessible, equitable, transparent and flexible were discussed. Drawn from different interviewee's suggestions, opportunities included incorporating: 'plugged-in' or easily replaceable models; multiple visions and

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[44] Readers may refer back to Chapter 2, Section 2.4.3 for methodological details of this meeting. In particular, note that the meeting was conducted mainly in Thai. Due to my heavy reliance during this meeting on participants' translations, this section contains limited analysis, and primarily reports significant agreements or decisions regarding the DSS or DSS development.

options; multiple forms of data (scientific and indigenous, economic, biophysical and social, quantitative and qualitative); and scientific and indigenous land use classification. During the meeting each of these opportunities was supported in concept, except that the incorporation of scientific and indigenous land use classification was altered to scientific and indigenous land capability classification at the behest of the DSS leader, who argued that this was a more appropriate term.

The meeting concluded with the anthropologist and the DSS leader each describing their vision of the DSS, and reaching agreement, supported by the other participants, on their common vision of the DSS. The anthropologist emphasised the potential for multiple forms of information output, and highlighted the opportunity for the DSS to assist negotiation or conflict resolution through equitable access to data. The DSS leader also raised the negotiation potential of the DSS, and described his realisation of the convergence of visions:

> "I just realise that we have a common idea because until last month, I have the idea that different components have different visions. But I find out this month that everybody has a similar vision about the whole project and we know the standpoint of each other. The common vision is that we have the participatory framework as the major output of the project. The structure of the output will have two steps. Firstly, the social team will develop mechanisms to form the forum for participatory framework. Secondly, the other three teams will provide tool to combine in DSS which will allow forum to negotiate".

Thus, the common vision reinforced earlier agreements that the DSS should be a part of the participatory framework, that the participatory framework should be viewed as the major output of the project, and that the DSS should assist negotiation amongst stakeholders within the policy forum intended to be developed as part of the participatory framework.

Following this meeting, the participants agreed that the forthcoming joint project meeting to be held in December in Australia would provide an opportunity to present the common Thai vision of the DSS and compare it to the Australian perspective.

6.4.6 Postscript to the Thai application

In mid-November, the Thai ambassador to Australia officially launched both the ACIAR-funded IWRAM project and a new research centre within the Australia National University called the Centre for Integrated Catchment Assessment and Management. The Director of the new centre was the Australian IWRAM project leader, and the IWRAM project was framed as one of its flagship projects. Thus, an institutional building motive for the initiation and successful delivery of the IWRAM project is now apparent from the Australian end. Note also that while, from the Australian side, the IWRAM project has begun, tied to a funding timeframe of three years, the Thai collaborators have not yet secured funding. Although the RPF agreed to the project, they expected to fund it from external research funds. However, bids to the National Research Fund and Thai Research Fund failed in part because of the Thai economic crisis of 1996/97. The significance of this in terms of who takes primary responsibility for driving the IWRAM research, and therefore shaping the DSS, will be explored in Chapter 7.

6.5 Confronting divergence? Meeting of the two teams

In December, the Thai biophysical leader, the anthropologist, the GIS researcher and an economist (not the same one as was interviewed during my process) travelled to Australia for a three-day joint team meeting. The Thai DSS leader and project manager both had family commitments and delegated their roles to the biophysical leader. The Australian team at the meeting included the project leader, project manager, sociocultural leader, and DSS leader, as well as a recently recruited economist, anthropologist and hydrologist.

The meeting opened with an information exchange about progress to date. The Thai delegates emphasised how the Thai economic crisis was affecting their progress and may require curtailing or restructuring of research activities. Thus, financial constraints had emerged as a significant factor shaping research.

As the meeting agenda shifted to an information exchange explicitly about the DSS, the Thai biophysical leader commented that he had met with the Thai DSS leader and understood better what the Royal Project Foundation wanted:

> "We want to have interaction between stakeholders and have them interacting in decision-making and this tool can help them participate... We think the DSS needs to be 3D so stakeholders can come and use it and help them understand and feel like they are a part of the decision-making process".

This suggests that the biophysical leader, who had been absent from the Thai group discussion of biases, supports the common vision of the DSS and the project negotiated during that discussion.

The Thai biophysical leader then explained that they were planning to have a meeting early in the following year to which they would invite different agencies and discuss how they could be involved from the beginning of the DSS development. Note that DSS development is assumed not to have commenced yet, despite the conceptual discussion and shaping which had taken place over the preceding three years.

The Australian sociocultural leader commented that it appeared from the Thai biophysical leader's report as if there was now a less sharp distinction between stakeholders and research collaborators. The Australian project leader supported this as a mechanism of encouraging ownership of the research. Later in the discussion, the issue of ownership with regard to the DSS arose again. The Australian DSS leader raised with the ACIAR (funding body) officer the tension between focussing on research outcomes in the form of academic outputs such as journal papers versus improved decision-making procedures in Thailand. The ACIAR officer responded that "At the end of the day, the outcome is the decision support system. And the project will be evaluated on that and also academic rigour. But mainly we have to show our stakeholders on the hill[45] that we have made a difference, so the DSS should do that". This statement suggests that the funding body favours a improvement in decision-making procedures over conventional academic outputs, but the project will be assessed on the basis of the DSS-as-product. Thus, a new perspective is provided on the

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[45] The phrase 'stakeholders on the hill' refers to the Australian government which is sited on a hill in the national capital, Canberra.

research/practice tension highlighted during the testing of the framework with the Australian participants.

Meanwhile, the Australian project manager argued that "We need to be careful to all remain committed to the primary objective of the project - developing frameworks. If we can encourage ownership beyond the life of the project, that is good; but we need to keep focussed on the primary objective". In contrast to the ACIAR officer's sentiments, the project manager reinforces the development of methodology as the central objective of the project rather than "making a difference" to the application context. The research-versus-use tension illustrated here between the timeframe of the project and the long term future will be revisited in Chapter 7.

According to the meeting agenda, each component was supposed to provide a report of their activities and progress. For the decision support component, the Australian project leader, chairing the meeting, mentioned that he favoured a modular approach to the DSS because the modules could be transferred to other projects later on. Thus, this segment of the meeting dedicated to discussion of the DSS opens with reinforcement of the mode of framing the DSS as a transferable modular software package.

The Australian DSS leader then presented his conceptualisation of the DSS and how it should integrate with the other project components. He emphasised that he saw stakeholders as the "pivot point" of the DSS. The Thai participants sat silently during this presentation and did not interject or ask questions. After some discussion amongst the Australians about the pros and cons of a modular approach, the day's discussion was adjourned.

On the third meeting day, the discussion opened with a query from the Australian DSS leader as to the scale of decision-making. The Australian sociocultural leader responded that a range of decisions operated at different levels. The new Australian anthropologist argued that ethnographic evidence supported the notion that land use decisions are only made at the individual farmer or household level. The Thai economist felt that it was possible to focus on decisions at an individual level and view all other decisions, such as government policy, as constraints on that individual. The Australian project leader argued that the discussion was getting too embroiled in policy and that the appropriate scale of decision-making would emerge through "looking at the land use and cover maps and see where the land is being underutilised or overutilised and then do some scenarios and see how that affects economic decisions". The new Australian economist countered that "land capability and land slope aren't the only factors affecting decisions - there are other things that affect economic decisions - availability of labour etc". This exchange illustrates how discipline may influence framing of a decision problem, both in terms of conceptualisation of scale and in terms of relevant factors that are perceived to drive or shape decision-making.

The afternoon session was devoted to another discussion of the DSS. First, the Australian project leader expanded on how the Australian team had conceptualised the DSS as three modules, consisting of LUPIS, ARCINFO and a stand-alone modelling system, probably EXTEND. The Australian DSS leader then presented his own conceptualisation of the DSS as a resolution to the earlier disagreement over scale, Figure 6.4. He suggested that there were two different types of decision problems, land allocation (larger scale) and land management (household or individual scale). Supporting the project leader's framing of the DSS, he described how the three modules

fitted within his diagram. A debate ensued amongst the Australian team as to the pros and cons of the different software and models, until the Australian project manager and project leader suggested adjourning the discussion to observe a demonstration of the Extend software. The Thai team had not interjected or commented on any of the DSS discussion thus far. When this was brought to the attention of the project manager, the Thais were provided ten minutes to explain their perspective. The GIS researcher and anthropologist both wished to present. The GIS researcher discussed the approach she hoped to take in terms of construction of a digital elevation model for the DSS. The anthropologist outlined the common vision for the DSS that had been agreed on during the joint Thai meeting, the need to communicate the same information in multiple ways, and features of the TAOs which he hoped to involve as a conduit to villagers. He emphasised that he saw the DSS as having two parts: firstly, data or information support; and secondly, a forum to debate options.

The discussion which ensued from the Thai presentation provides a useful point to take stock of the Australian participants' perspectives before I draw the curtains on this narrative of evolving perspectives of decision support. Firstly, the Australian sociocultural leader suggested that according to the Thai perspective, "our whole project is now a Decision Support System - stakeholders, a participatory process, what the people want to do to resolve problems, and data is just a support to that". Thus, her perspective on decision support had shifted from deep distrust of a software system that she felt was in conflict with participatory ethics, to positive framing of decision support as a participatory process of stakeholder interaction to guide resolution of their problems. She subsequently prepared a diagram illustrating her perspective of the DSS according to this latter framing, Figure 6.5.

In response to a question from the ACIAR officer seeking clarification as to whether the project was developing the DSS for both direct and indirect users, the Australian project leader remarked: "Do you think that as a minimum we could develop it just for the core direct users, and then do what we can to communicate the output to indirect users within budget and other constraints?". Thus, the project leader's perspective has remained consistent with his original concern for providing a suitable software product within the funded project timeframe. However, he is also open to the possibility of providing for wider access if managerial demands allowed.

The Australian DSS leader commented that "We need to concentrate on direct and indirect users and how they make decisions... We want to have one system that all users, direct and indirect, can take and use... The DSS has a software component and a non-software component which includes mechanisms for [the users] to interact with and feedback to the DSS". Over the course of this narrative, he had shifted from regarding development of the DSS primarily as a research exercise in constructing an operational software system which could examine hypothetical trade-offs, to framing the DSS as a reflexive system necessarily embedded in and interacting with the users' decision-making environment.

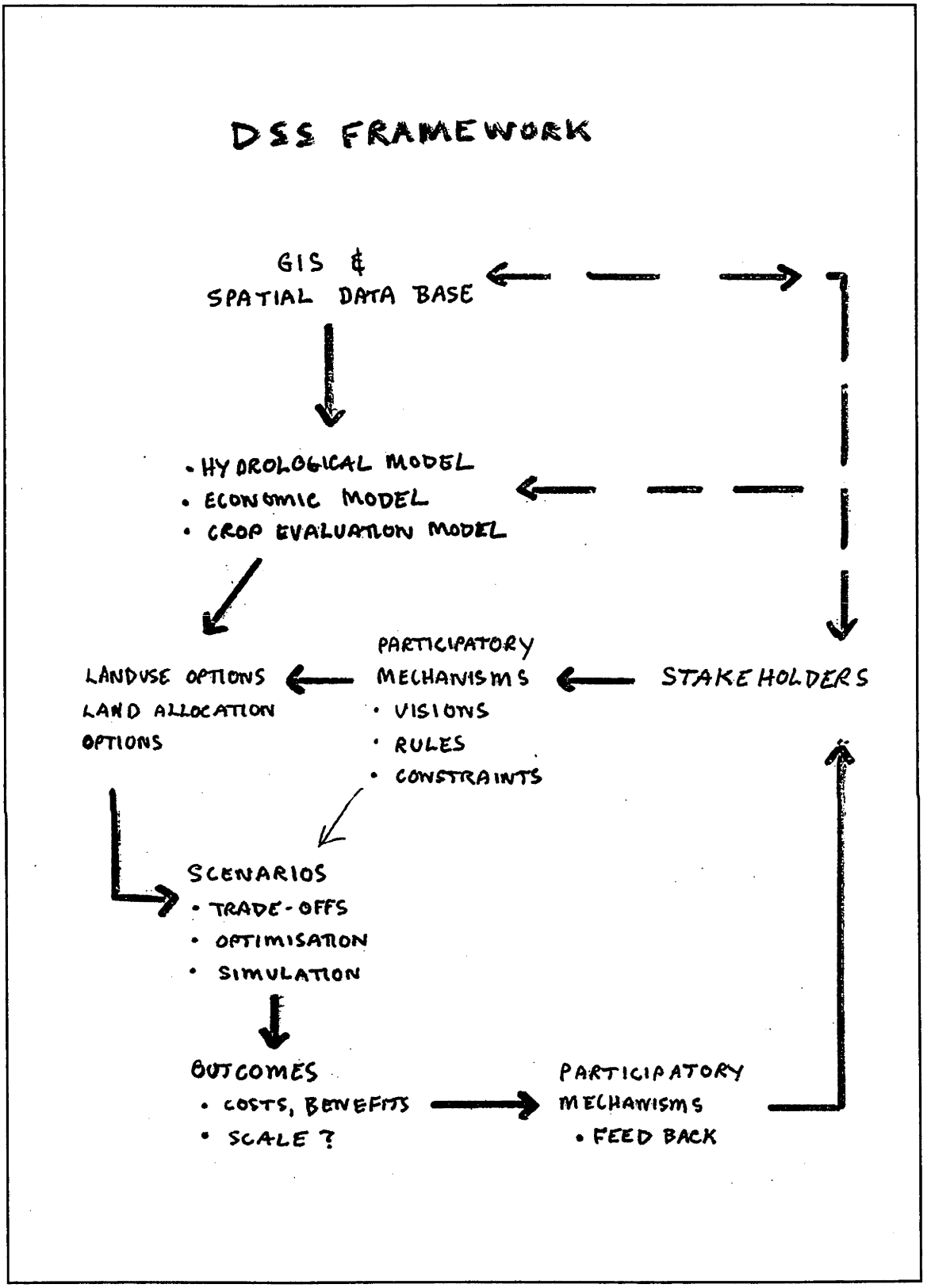
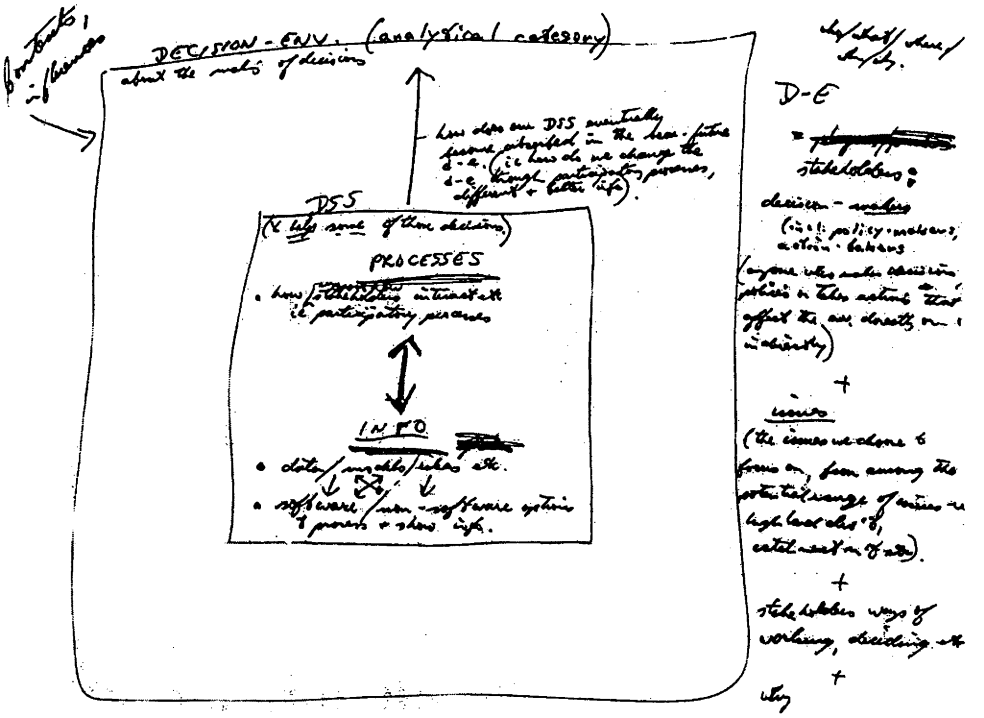


Figure 6-4 Framing the DSS: Australian DSS leader, December 1997



Transcript of above diagram

Contexts, influences

DECISION-ENVIRONMENT (analytical category) about the making of decisions

how does our DSS eventually become absorbed into the near-future d.e. (i.e. how do we change the d.e. through participatory processes, different and better info)

DSS

(to help some of those decisions)

PROCESSES

- how we support how stakeholders interact etc ie. participatory

INFO

- data/models/ideas etc
- software/non-software options & process to show info

who/what/where/ when/why

Decision environment = stakeholders: decision -makers (including policymakers, action-takers (anyone who makes decisions, policies or takes actions that affect the environment directly or indirectly))

+

issues (the issues we choose to focus on, from among the potential range of issues re highland development, catchment management etc)

+

stakeholders ways of working, deciding etc

+

why

Figure 6-5 Framing the DSS: Australian sociocultural leader, February 1998

6.6 Postscript

The narrative described above must be emphasised as a time-slice of the IWRAM project. Since I ceased intensive interaction with the IWRAM project, the project, the nature of the DSS, and the decision-making environment have continued to evolve. The approach to DSS development proposed in Chapter 4 was intended to be iterative to reflect and respond to the dynamic nature of the development process. However, because of the time limitations of this thesis, my intensive interaction was necessarily restricted to the period detailed above. For several months following the meeting detailed above, I observed the evolution of the IWRAM project at a distance. During this period, a few events took place which had significant implications for the IWRAM DSS, and which influenced the extent to which biases received attention. Firstly, as the Thai economic crisis became protracted, the resource and funding situation for the Thai collaborators worsened. Fewer personnel were available to work on the project, and in some fields, public servants had to substitute for academic collaborators. Secondly, the Thai anthropologist moved to Australia, in the hope of starting a PhD. His absence from the Thai team for several months resulted in weak supervision at a vital stage of the socioeconomic field data collection and logistical difficulties in processing and translating the information. Later, the anthropologist lost his job, leaving the sociocultural component with very little research and liaison capacity. Thirdly, the new appointees to the Australian IWRAM team took increasing control over the DSS development process. These implications of these events will be expanded on in Chapter 7.

6.7 Conclusions

Through presenting the diversity of framings of decision support by different IWRAM participants, this chapter has demonstrated the interpretive flexibility of the term 'decision support system'. By detailing different participants' perceptions of potential biases, this chapter has also provided grounded support for the relevance and significance of an interrogation of biases in this particular DSS development process.

As discussed in Chapter 3, the development of DSS tends to be portrayed as an objective technical exercise. However, this narrative has illustrated that prior to any tangible steps being taken to build the DSS, the process of framing and shaping the IWRAM DSS has already been enmeshed within networks of sociopolitical and personal commitments. Professional interests and aspirations, strategic institutional building, ethical concerns, disciplinary commitments to methodology, pressures to satisfy funding bodies, and aspirations for furthering sociopolitical empowerment are among the factors which appear to have contributed to the way in which different participants framed the nature and role of decision support. Participants' modes of framing the DSS and DSS development also seemed to reflect normative constructions of the highland decision-making environment, including assumptions about stakeholder identities, the relationships between stakeholders, and problem definition. Tensions between divergent modes of framing the DSS or DSS development thus seem to represent tensions between competing interests and commitments. This theme will be explored in Chapter 7.

This narrative has also illustrated that participant's perspectives of the nature and role of decision support did not evolve linearly as a result of engaging with the questions from the framework for anticipating bias. Instead, issues which challenged participants' perspectives often became subject to a circular process of consideration, rejection or internalisation, reconsideration, rejection or internalisation, and so on. The IWRAM DSS was continually (re) constituted and (re)constructed through this process. As a consequence of this circularity, problems of divergence in perspective were seldom resolved neatly, and thus tensions between alternate modes of framing decision support tended to recur throughout the narrative. The implications of this circularity for an assessment of the effectiveness of the framework will also be discussed in Chapter 7.

Probing the frames

Most highland villages continue to engage in traditional subsistence activities, including livestock raising. However, over the past two decades, many villages have diversified beyond their traditional activities, including stone fruit cultivation for the lowland markets and handicraft production for the tourist industry. In the top photo, playing to tourists who seek hill tribe silver jewellery, a tinsmith (the Thai signage) has translated his services as a 'silversmith'.

7. Probing the frames

7.1 Introduction

This chapter analyses both the framing of decision support and the interrogation of biases in the IWRAM project. The initial part of the chapter explores recurring tensions between alternate modes of framing decision support which emerged during the discursive interrogation of biases by collaborators in the IWRAM project. Although distinctions and potential incoherencies between alternate framings are emphasised for comparative purposes, it should be stressed that framings are not dichotomous. Rather, some participants concurrently voiced alternate framings, which constituted different dimensions of, and were realised to different degrees within, their whole construing of decision support. Consequently, tensions were evident both between participants and within the construing of an individual participant. Section 7.3 discusses sociopolitical networks which appear to have contributed to the conceptual shaping of the IWRAM DSS. Drawing on the experience of the IWRAM project, Section 7.4 assesses how the theoretically-derived analytical framework for interrogating and anticipating biases performed in practice.

7.2 Framing environmental decision support: Tensions

7.2.1 Differing motives: DSS for research or practice?

One key tension which emerged was between framing development of the IWRAM DSS foremost as a research project or as a means of supporting the practice of highland environmental decision-making. Each perspective was associated with differing construing of environmental decision support, differing approaches to highland environmental problem-solving and decision-making, and differing expectations of how the DSS development process should be conducted, Table 7.1. For instance, the DSS-for-research perspective construed the primary objective of the IWRAM project as developing integrated frameworks, and the primary function of the DSS as a modular software system. In part, the modular approach was favoured because, because unlike a fully integrated system, it would enable individual component modules to be transferred relatively easily to future research projects. In contrast, the DSS-for-practice perspective construed the project as fundamentally about helping highland stakeholders to make decisions: "our whole project is now a Decision Support System - stakeholders, a participatory process, what the people want to do to resolve problems, and data is just a support to that". From this standpoint, the DSS was framed as an interpersonal process necessarily embedded in the decision-making environment of the application locality. As recognised by the Australian DSS leader from the outset of the discursive process, the preceding framings were not inherently compatible, since it was conceivable that the researchers could develop "an academically interesting system", but "fail to deliver an operational system".

When queried as to the purpose of the DSS, researchers within the DSS-for-practice group tended to implicate conflict resolution and negotiation, often giving an anecdote from their personal experience about a particular highland conflict. Thus, the focus was on a

grounded problem and how a DSS might support it. In contrast, the DSS-for-research perspective tended to raise the potential for the DSS to explore hypothetical solutions, placing the emphasis on the technology and how it might inform consideration of abstract options.

Framing decision support	*DSS for research*	*DSS for practice*
DSS primarily framed as:	Transferable software tool	Locally embedded process
Purpose of DSS:	To explore hypothetical options	Awareness, conflict resolution, negotiation
Users of DSS:	Unsure	Potentially all stakeholders
Supporting IEM	By integrating data and analyses	By encouraging stakeholder interaction
Participatory DSS development:	To enable efficient project management	To promote local ownership
DSS development timeframe	Funded project timeframe	Unspecified, long term timeframe
Anticipating embedded biases	Moderate interest in acknowledging uncertainty	Moderate interest in acknowledging distorted knowledge and absences in knowledge
Anticipating biases in access	Limited interest in biases in access	Considerable interest in communication constraints

Table 7-1 Divergent framings: Comparing DSS-for-research and DSS-for-practice

The two modes of framing also approached integrated management in different ways. The DSS-for-research perspective tended to emphasise supporting integrated assessment via integrating disciplinary analysis (primarily biophysical and economic). The DSS (framed as a computer-based tool) tended to be cast as a focus for this integration, by combining different models with an integrated database to allow systems modelling. In contrast, the DSS-for-practice perspective tended to portray the task of supporting integrated management as supporting communication and interaction within a stakeholder-based process, with software and other information playing a role in informing the stakeholders.

The DSS-for-research and DSS-for practice perspectives were associated with different timeframes. Those researchers for whom a DSS-for-research perspective had primacy focussed on the funded three-year project timeframe. This had significant implications for the management of biases in access since these researchers had limited motivation to consider practice issues which were likely to become prominent after the funded timeframe was completed. As the Australian project manager commented, "If we can encourage ownership beyond the life of the project, that is good; but we have to keep focussed on the primary objective". Emphasis was placed on the need to deliver, at the end of the funded time-frame, the tangible research outputs and products specified within the research

proposal. Consequently, technical research activities received prominence and were rapidly assigned to particular researchers, while responsibility for practice-related tasks, such as interacting with users, remained more ambiguous.

The DSS-for-practice perspective tended to have a longer term vision for the DSS and see it as a possible mechanism to promote a fundamental change in the conduct of highland environmental decision-making. This perspective was more interested in potential biases in access, particularly literacy or other communication constraints and the potential for capture of the DSS by elites. Highlighting the impacts that the DSS could have on people's livelihoods, the DSS-for-practice perspective cast the communication of embedded biases, particularly distortions or absences in knowledge, as an ethical imperative. While also interested in identifying and quantifying uncertainty and confidence bounds, the DSS-for-research perspective treated the task more as a dimension of ensuring academic rigour. In terms of management of biases, the DSS-for-research emphasis on efficiency and delivery of tangible products translated into an interest, once a bias had been identified, in enacting an appropriate management strategy to enable closure. The DSS-for-practice perspective was more reluctant to take management action until wider consultation had taken place amongst a wider stakeholder group about possible strategies.

As recognised by the Australian sociocultural leader, the tensions between focussing on a research or a practice timeframe could have significant implications for the content of the DSS. She noted that, as a funded research project, the temptation would be to generate a rich database which would enhance the DSS product the researchers were required to deliver at the end of their three-year project. However, generation of a rich database through labour- and resource-intensive fieldwork could mean that updating the database might also prove labour- and resource-intensive. Without the injection of funds from a well-resourced foreign project, this task could prove difficult for Thai stakeholders. The dilemma raised here reflects a common tension between the differing methodological interests of researchers, who often want to demonstrate state-of-the-art methodology, and practitioners, who tend to favour the pragmatic choice (Syme and Sadler 1994:534). In the IWRAM project, the bias implications of electing to generate the richest database possible would include the risk that distortions in knowledge arise as the data becomes outdated, or that absences in knowledge arise as data becomes insufficient in light of the changing decision-making environment. The sociocultural leader noted that an alternate practice-focussed approach would be more targeted and scope the contents of the DSS according to realistic expectations of the capacity of potential users to update the data. The implications of this latter approach in terms of bias would be absences of knowledge, specifically absences of sociocultural and economic information which relied on extensive and intensive field surveying. This highlights how a new methodological approach, developed to manage the biases associated with a previous methodological approach, may introduce new forms of bias. Management of bias is not a one-off exercise in discerning and applying the most bias-free method, but involves a continuous process of critically appraising potential biases and iteratively adapting methods as an integral dimension of precautionary practice.

The notion of a stakeholder advisory committee arose during the dialogues as one means of responding to the upgrading dilemma. The differing framing by the DSS-for-research and DSS-for-practice perspectives of the rationale for a stakeholder advisory committee provides a useful means of exploring their differing construing of participation. The DSS-

for-practice perspective tended to regard participatory methodology as fundamental to encourage local ownership and thereby facilitate effective research extension into practice. Consequently, within this perspective, the stakeholder advisory committee was framed as a means of promoting stakeholder trust in the research. Meanwhile, the DSS-for-research perspective tended to view participation as a mechanism enabling more efficient management of the project. Accordingly, the stakeholder advisory committee was framed as a means of delegating responsibility for practice issues, such as questions of access and upgrading the DSS, to the stakeholders. The DSS-for-research perspective also cast formation of the stakeholder committee as the responsibility of the Thai research team "since they've got to wear it", thereby suggesting research ethics as justification to delegate practice issues to the Thais.

During his review of the case study narrative (Chapter 6), the Australian project leader queried the contrast made between a DSS-for-research and a DSS-for-practice, arguing that "no-one ever wanted a DSS-for-research only". Indeed, this observation is largely supported by the case study narrative, which illustrates that most participants wanted the DSS to "be more than just a computer". However, the preceding analysis suggests that even if all participants wish to develop a system that simultaneously fulfils both research and practice goals, there are inevitable tensions in attempting this task. This conclusion is supported by Barnes et al. (1997) who argue that models for research application are fundamentally different in objective, form and function from models for practical decision support. As an illustration of their position, Barnes et al. (1997) suggest that the complexity of models-for-research is determined by the hypothesis underpinning the model, whereas the complexity of models-for-decision support is dictated by the data available. Thus, in the former case, the data requirements are specified by the model, while in the latter case, the model is specified by the data. This observation clearly reinforces the upgrading dilemma identified by the Australian sociocultural leader.

Literature examining the influence of economic rationalism and managerialism on research practice suggests that the focus on the marketable, transferable products and shorter timeframes associated with the DSS-as-research perspective arises from a disintegration of conventional distinctions between pure and applied research. Marginson (1997:261) reviews the ensuing reconstruction of research as entrepreneurial: "basic research penetrated by an applied mission, with an eye on technology transfer". Within Australia, political pressure on researchers to minimise costs, attract external funds and adopt private sector management models has resulted in greater emphasis being placed on delivery in the short-term of tangible, and increasingly saleable, research outputs and products (Stewart 1997, Orchard 1998:21,23). As Mathews (1990 cited in Marginson 1997) argues, within the new research paradigm, "academics are expected to conduct their research to schedule, offer a product for which there is an identifiable market, and compete for a buyer in that market". Community development researchers point out that this emphasis on tangible products may conflict with the more long-term and less tangible outcomes associated with effective community-based practice. As Gohlert (1991:58) argues, "the ability of the people to identify the source of their problems, to formulate, implement and assess responses to these challenges entails a complex, subtle and usually slow learning process that is reflected in a gradually growing awareness and consciousness of critical factors in their economic, social and political environments".

A number of other systemic pressures act to dissuade researchers from giving primacy to a practice perspective. In particular, the research reward system tends to reinforce the

mainstream perspective that linking research to grounded action detracts the researcher from their primary role of conducting basic research (Whyte 1991:8, Guerin and Guerin 1994:563). For example, career promotion rests heavily on publication in peer-reviewed journals, with limited credit accorded to the substantial amounts of time necessary to engage in practice with participants in or users of research outcomes. As Ewing et al. (1997:2) observe, "the reward system is such that, beyond publication and research awards, active involvement with end-users is distinctly less glamorous and still at the margins of the academic system". As a result, the low career enhancement potential of practice activities encourages many researchers to relegate such activities to second priority.

Combating the systemic discouragement within the scientific community of greater emphasis on practice, funding bodies increasingly require researchers to specify the practical relevance of their research and technology extension or adoption strategy (Ewing et al.. 1997:2). The funding body may thus be viewed as a broker between demand (the users of research) and supply (the researchers). Within the IWRAM experience, the funding body directed that the research be both policy-relevant and practically-oriented, thereby meeting demand imperatives, and academically rigorous to satisfy supply imperatives. Thus, opportunities exist for funding bodies to mediate discursively between incoherent research and practice commitments, and thereby to facilitate negotiation of a form of DSS, and DSS development, which is of mutual interest and benefit to both research and practice perspectives. However, these opportunities are constrained by contemporary norms of funding practice, whereby a requirement for material accountability and flexibility prescribe shorter funding timeframes and thus a short-term outcome orientation, reinforcing the research behaviour described previously (Gohlert 1991:58).

7.2.2 Differing construing of stakeholders: Who should use the DSS and how?

The IWRAM case study illustrated that differences in the way that researchers construe stakeholders and the relationships between them may also lead to different ways of framing the DSS. In particular, different ways of construing stakeholder identities and relationships emerged during the Thai application which had divergent implications for the character of the DSS, who should use the DSS and how users should interact with the DSS. Two alternate perspectives are contrasted in Table 7.2. It should be noted that although the divergent ways in which the form of the DSS was construed under each perspective did correspond to the practice-research contrast, overall, each tended towards the practice perspective.

The first 'empowerment' perspective construed villagers as disempowered in highland environmental decision-making and cast the DSS as a possible mechanism to realise the visions of the new Thai constitution regarding increased local participation in natural resource decision-making. (In)equity was an important consideration within this perspective, with proponents relating anecdotes highlighting the conventional denial of local knowledge by government officials in concert with scientists, the complex web of historical political and economic pressures which had contributed to the contemporary highland environmental dilemma, and the barriers confronting villagers wishing to gain access to either environmental information or highland decision-making. Open access to the DSS, and the decentralisation of access to both information and the construction of highland policy, was cast as imperative for more participatory decision-making. To promote open access, and manage biases in access, the need for multiple modes of

	Empowerment perspective	*Expert perspective*
Villagers construed as:	Disempowered	Naive, stubborn
Highland environmental dilemma caused by:	Historical political and economic pressures	Villagers' bad practices implicated
DSS framed as:	Mechanism to realise more participatory, open and decentralised decision-making	Means of convincing villagers to follow expert advice about best land use practice
Purpose of DSS:	Awareness, conflict resolution, negotiation	To present the best land management solutions
Users of DSS:	Open access	Government officers, some NGOs, researchers
Developers of DSS:	Stakeholders and researchers	Researchers with direction from government officers
Content of DSS:	Multiple kinds of information: qualitative and quantitative; local and scientific expertise; socioeconomic and biophysical	Biophysical analyses re land use patterns, social information re willingness of villagers to change, economic information re income potential
Form of DSS:	Policy processes and mechanisms incorporating multiple modes of communicating output, not just software	Colour computer monitor displaying 3D models
Anticipating embedded bias:	Vocal about embedded biases especially distorted knowledge and absence of knowledge	Should communicate assumptions and uncertainties to users; villagers won't question output
Anticipating biased access:	Vocal about biases in access especially communication constraints	DSS should be free to use and in Thai
Participation framed as:	Open access to DSS, decentralisation of environmental decision-making	Collecting data from villagers makes them aware of the DSS

Table 7-2 Alternate framings of the DSS: Differing construing of stakeholder relationships

communicating the information output of the DSS was emphasised. Communication modes identified included computers for academics, tables for policymakers, and posters or 3D topographic models for villagers. To promote holistic analysis and decision-making, the need for multiple forms of information (qualitative and quantitative, indigenous and scientific, sociocultural and biophysical) within the DSS was also emphasised.

Consequently, it was argued that the DSS should be a combination of policy mechanisms and information, rather than just software which only policymakers would be likely to be able to use. In this context, a distinction was made between 'decision software' and a holistic, process-based 'decision support system'. However, it was also suggested that some villagers would be interested in empowering themselves by learning to use the technology, and the project should accommodate them. Finally, it was argued that stakeholders, not just researchers, should actively participate in both conceptual and practical development of the DSS to guard against embedded absences and distortions of knowledge, and to ensure that the characteristics of the DSS were suitable for the highland environment and people.

A second 'expert' perspective construed villagers as naive, stubbornly clinging to outdated, suboptimal cultivation practices which were causing environmental degradation and conflict. Within this perspective, the DSS was framed as providing expert users (identified as researchers, government officials and some NGOs) with greater authority and credibility when trying to convince villagers of the best land use solutions. As the Thai biophysical leader commented, "Sometimes we want the villagers to change from their old cultivation to a new system but its hard to tell them... If it is easy enough for villagers to see [on the DSS screen], it will help us to have them believe us". Users were thus distinguished from villagers, who were cast as passive recipients of the DSS output. The form of the DSS was construed as a computer-based colour monitor displaying 3D graphical models, and as a foreign technology which would awe villagers into following the users' opinions without question. Yet, it was argued that the DSS would increase villager participation because the villagers would be required to provide information and would thereby become aware of the DSS. In terms of content, it was proposed that the DSS should incorporate biophysical analyses regarding land use patterns, economic data about the income potential of different crops, and social information about the willingness of different tribes to change their cultivation practices. It was argued that the uncertainties and assumptions associated with this information and analyses should be communicated to the users so that they were aware of the limits to the system's predictive accuracy. It was also argued that it was not necessary to tackle the difficult problem of communicating assumptions and uncertainties to villagers because, due to their naivety, they were unlikely to question the output of the DSS.

An issue raised during the Thai interviews regarding land capability illustrates how these alternate ways of construing stakeholders may shape the content of DSS. The issue concerned the type of land classification system that would be used to underpin land capability analysis. The empowerment perspective valued local knowledge and ways of knowing, and therefore felt that the indigenous land classification system should be incorporated in addition to the scientific system. However, the expert perspective, which dismissed villagers' ways of knowing as naive and simplistic compared with the scientific system, argued that it would be sufficient to incorporate only the scientific viewpoint. Since, as illustrated in Ch 6, indigenous and scientific land capability assessments address different factors, then exclusion of one or other system would lead to different data and output, thus introducing different biases.

The perspectives contrasted above echo alternate conceptions of development described in Chapters 4 and 5. The empowerment perspective aligns with community-oriented, participatory development, while the expert perspective resonates with technocratic conceptions of development and reinforces elitist social structures. These perspectives

represent extremes of a continuum, and many Thai participants held views in-between. Introducing the range of perspectives at this point is useful to explore subtle differences in the way in which participation was construed by different Thai researchers, and how this shaped their differing framing of the DSS.

Noting villagers' perceptions that technology had been (mis)used in the past by officials to gain authority to impose their land use plans, the anthropologist suggested that the DSS could enhance villagers' power to negotiate by ensuring equality of access to the technology. He favoured broad stakeholder participation in conceptual and practical development of the DSS to guard against embedded biases, particularly the risk that only conventional scientific options which promoted technology to maximise profit would be considered.

The project manager also favoured active participation by all stakeholders in development of the DSS. Noting that each stakeholder, including himself as a forestry official, could only see the issue from their limited point of view, he argued that many people from diverse backgrounds should meet and debate the information to be incorporated in the DSS. He framed the role of the DSS as promoting villagers' understanding of what they needed to do to protect the environment, so that they no longer needed government officials to help them. Thus, the DSS represented a means of enhancing independence and decentralisation.

The economist suggested that the DSS could serve as conflict resolution tool by providing all stakeholders with same information. In contrast to the anthropologist, the economist framed a less active role for stakeholders in development of the DSS, but maintained that this mode of involvement would increase villagers' participation in decision-making. She argued that inputting stakeholders' visions and other information collected during field surveys into the DSS models would ensure decisionmakers considered their views, and that this would entail greater participation.

The GIS researcher construed the purpose of the DSS as assisting to reduce conflicts by informing highland villagers of the harmful effects of their bad practices. Implicating ignorance as the cause of conflict, she reasoned that if villagers were more aware of their impacts on downstream environmental quality, they would change their behaviour. She felt that the DSS would definitely improve participation by providing greater access to information. She also suggested that the DSS might decrease participation of villagers if the technology did not actually provide better information, or if the villagers automatically deferred to the technology rather than making informed decisions themselves.

The DSS leader also construed the DSS as a conflict resolution tool, but framed its role as an expert arbiter which would provide scientific authority to support different stakeholders' arguments. He felt that the DSS would improve the quality of participation by improving the information base, and that it might decrease the participation in decision-making of those stakeholders whose position was demonstrated by the DSS not to be credible. The DSS leader suggested that stakeholders should be consulted from the beginning of development, that their perspectives should be conveyed by the social researchers, and that an effort should be made to accommodate them.

The biophysical leader's approach aligned with the expert perspective. He construed DSS development as a technical task for researchers, to be guided by the goals of officials from the Royal Project Foundation and the Land Development Department. While he did not foresee an active role for stakeholders in DSS development, he felt that the DSS would

increase their participation in decision-making as data collection for the IWRAM project would make villagers aware of the DSS. Like the DSS leader, the biophysical leader framed the DSS as a source of expertise. However, rather than construing the DSS as an arbiter in negotiations, he suggested that the DSS would provide non-local actors with credibility and authority to enact policies within villages.

Arnstein's (1969) classic ladder of citizen participation, illustrated in Figure 7.1, is designed to evaluate the extent of citizen power in decision-making. The bottom rungs of the ladder are manipulation and therapy, whereby the powerful attempt to educate citizens as to the 'right' decision. Arnstein describes the mid-rungs as tokenistic participation in the sense that citizens may voice their perspectives but have no power to ensure their views are heeded. At the top of the ladder, citizens gain increasing degrees of power in decision-making, from negotiating decisions with other stakeholders through to full decision-making power. Arnstein's top rungs accord broadly with the empowerment perspective, and the bottom rungs accord broadly with the expert perspective. However, as a one-dimensional linear scale, Arnstein's ladder is less useful to contrast the range of Thai conceptions of participation, since perspectives tended to cut across the ladder's rungs. For example, most of the researchers implicate the DSS's informing role as the basis of expectations of increased stakeholder participation. Within this broader framing, different researchers cast the DSS as promoting greater citizen power in decision-making (e.g. the project manager), as enhancing access to negotiations (e.g. the anthropologist and economist), or in a therapeutic educative role (e.g. the GIS researcher). Of those researchers who construe the DSS as a source of expertise, the DSS is again cast as improving participation within negotiations by promoting accountability (e.g. the DSS leader) or in a therapeutic educative role (e.g. the biophysical leader). Within the context of DSS as fulfilling an informing role, Figure 7.2 reconstructs Arnstein's participation ladder as a two-dimensional schema to better reflect Thai conceptions of participation. Figure 7.2 could be extended to encompass further dimensions by considering framings in greater detail. For example, although the anthropologist and economist both frame the DSS as a negotiative tool, the anthropologist argues that participatory decision-making demands active stakeholder participation in DSS development, while the economist suggests that a more passive information-provision role is sufficient.

While Arnstein implies that the upper rungs of her ladder entail 'good' participation, and the lower rungs 'bad', Dovers (1998) notes that different rungs of the ladder may represent appropriate participation under different circumstances. This also applies to the adapted schema illustrated in Figure 7.2. For example, a villager may wish to be intimately involved in conceptualisation of the decision which the DSS may inform, and validation of the information to be incorporated as relevant, but then use the DSS for educative, therapeutic purposes. Or, given limited resources, a DSS developer may decide to engage a few key stakeholders in the design and development phases, and rely on their credibility to promote broader acceptance of and trust in the DSS and DSS output. Neither of these situations is inherently 'bad' or 'good' participation. Instead, each involves positioned trade-offs between feasibility, adequacy and intensity of participation. In the case of the IWRAM project, the need to address these trade-offs is becoming more apparent as the

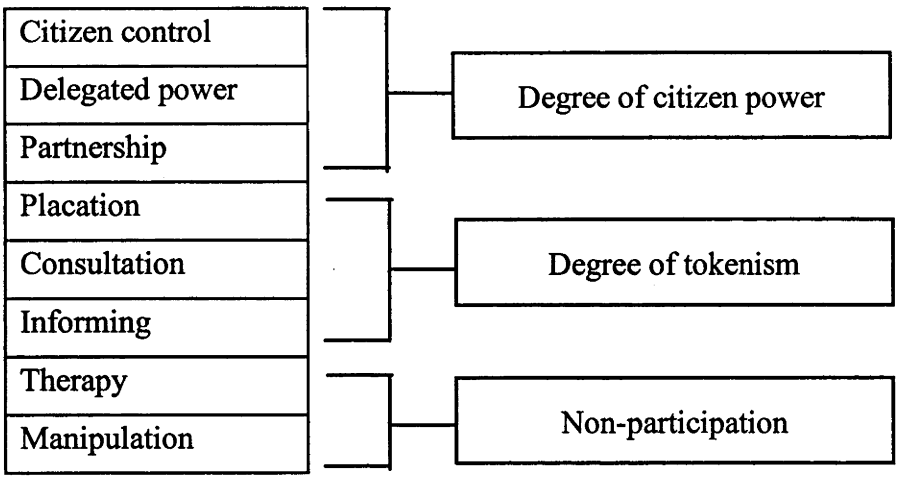


Figure 7-1 Arnstein's (1969) ladder of participation

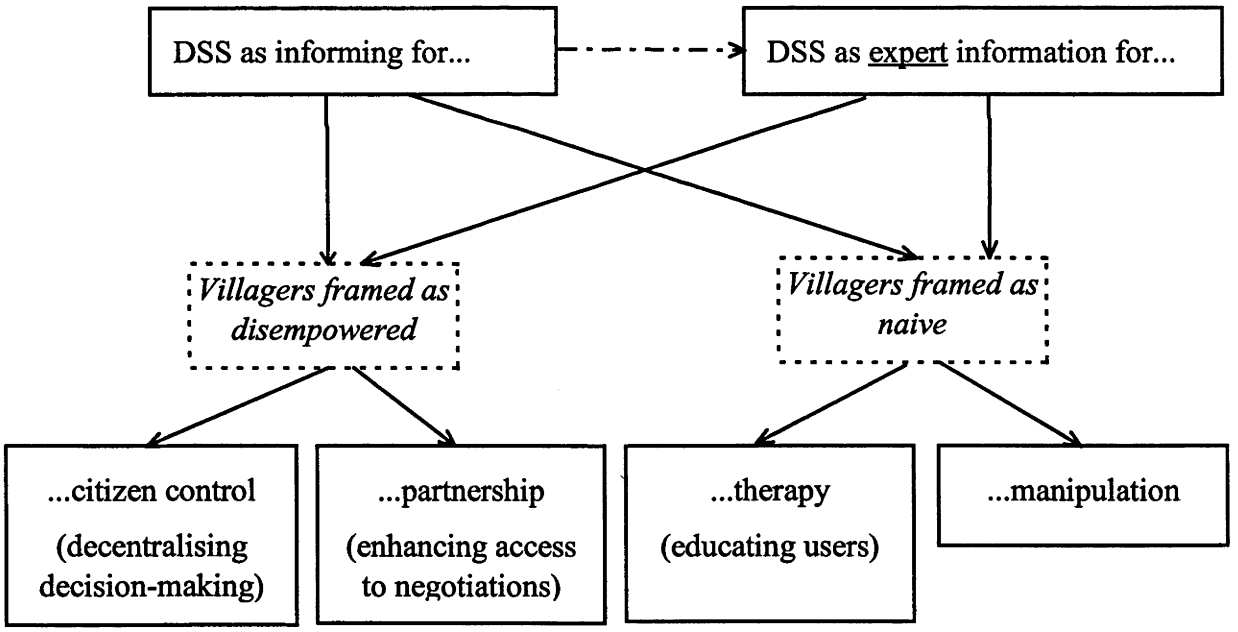


Figure 7-2 Thai team's conceptions of participation and the DSS

project moves closer towards finalising the selection of participatory mechanisms. Since both time and financial resources are constrained, and the project's participatory capacity has diminished because of the withdrawal of most of the Thai sociocultural team, the intensity of participation which was originally planned has had to be scaled back. The remaining IWRAM sociocultural team is currently debating such as questions as:

- Should participation in the IWRAM project work through existing, participatory structures? On the one hand, this approach may be more feasible, but it may also reinforce conventional power inequities.
- To what extent should stakeholder access be promoted at the expense of the modelling power and sophistication of the DSS?
- How can local perspectives be incorporated into the DSS? Noting that the users of the DSS will not be local stakeholders, one of the Thai sociocultural team was concerned that local stakeholders' visions might only be incorporated in the DSS as information, and would not directly drive scenario modelling. She suggested that if local stakeholders' perspectives did not affect the users of the DSS unless they chose to pay attention to them, then users would be likely to ignore them. At present, however, it is planned that local stakeholders' visions will play an important part in scenario generation, model development and output indicators.

Regardless of the form of participation selected, continued critical interrogation of the biases engaged in the process of DSS development and use, and of the emerging impacts of the DSS on stakeholders' interactions, is necessary to monitor whether the participatory approach adopted is appropriate for the given circumstances.

7.2.3 Differing construing of decision-making: Disciplinarity emerges

Disciplinarity and social construction of science literature suggests that, through training and a sense of community, disciplinarity tends to colour a researcher's identification of problems, methodological approach and assumptions, and their criteria for success (Messer-Davidow et al. 1993, Rhoades et al. 1986). The IWRAM case study provided a grounded illustration of how participants' construing of both decision making and problem-solving may be influenced by disciplinarity. For instance, at a broad framing level, researchers from a biophysical background tended to align with a framing of the DSS as a technical product, while social researchers tended to reinforce a practice and empowerment focus. Different disciplinary conceptions of the appropriate scale of analysis to be incorporated in the DSS provides a more detailed example. From the outset, the IWRAM project focussed on the basin and catchment scales as appropriate scales of analysis; an approach which accorded with the research interests of the Australian project leader and sociocultural leader, as well as with current environmental management trends. As the project progressed, and individual researchers began to grapple with how their methodology and analyses would fit within the integrated project, alternate perspectives emerged as to the appropriate scale of analysis. As Norgaard (1994:161) notes, how we see scale and boundaries depends on who is asking which questions, and what is deemed important. In the IWRAM project, alternate conceptions of scale crystallised during the joint team discussions, where several researchers argued for primacy of their individual viewpoints, as illustrated in Table 7.3. Embedding commitments to one of these viewpoints within the DSS would serve to validate the corresponding analytical perspective and potentially disempower alternate disciplinary constructions.

Disciplinary background	*Framing decision making: scales of analysis*
Sociology/psychology	Range of decisions operate at different social levels
Anthropology	Decisions made only at individual or household level
Economics	Focus on individual decisions; view all other scales of decisions as constraints
Hydrology/environmental systems modelling	Appropriate scale will emerge from examining land use and land cover data and performing scenario analysis
Geography/GIS	Multiple scales are possible, but accuracy varies according to scale.

Table 7-3 Disciplinarity within Australian team: Framing decision-making scales

The diversity and divergence of the disciplinary-based framings of decision support indicate a key challenge facing groups who are attempting to develop an integrated DSS. As disciplinary biases attenuated towards the conclusion of my involvement with the IWRAM project, they were only dealt with at a basic, cursory level during the group dialogues. However, the potential exists to use the theoretical critical and collaborative learning concepts underlying the analytical framework to deconstruct disciplinary biases and negotiate an appropriate framing of decision support to allow the joint enterprise to progress. During this process, it may be useful to draw conceptually on bodies of knowledge which already construe decision-making in a multifaceted way, such as public policy discourse, to guide an integrative strategy.

Within the Thai interviews, disciplinarity also emerged in relation to the differing roles of different research components in the development of the DSS. In particular, in the context of discussion about embedded bias, the Thai anthropologist raised concerns that the sociocultural component was being marginalised by playing only an information provision rather than a conceptual role in development. This introduces the interrelated issues of the differing degrees of authority accorded to different disciplines (Keller 1993:57), and the differing degrees to which the perspectives of different disciplines may contribute to the strategic goals and direction of the joint enterprise. Note that the potential of either a technical or a process-oriented DSS to catalyse integration may be undermined or compromised if particular disciplines are not validated to contribute to that particular form of DSS. Thus, to give a hypothetical example, if the IWRAM DSS is presupposed to be a technical, quantitative software-based system, and the sociocultural team is expected to contribute primarily in a qualitative, process-oriented way, then their participation in the development of the DSS is more open to marginalisation. However, the potential for DSS to act as an integrative mechanism may be enhanced through application of the analytical framework for interrogating bias by facilitating transparency of instances of disciplinary domination and bias. Similar to the Thai anthropologist's concerns, Rhoades et al. (1986:24) discuss the frustrations experienced by anthropologists in an interdisciplinary team who felt that their role in the project was being defined by economists and agronomists, and that they were therein being limited to a service role. This suggests that disciplinary-based interactions may be significant in terms of the differential participation of different researchers in any interdisciplinary enterprise. Consequently, this raises the possibility for the analytical framework for interrogating bias to be modified and

reconstructed as a tool for exposing disciplinary politics and biases in any interdisciplinary project, not only those focussing on developing a DSS.

It should be noted that in some instances dialogue about integration appeared to be partly constrained by researchers' desire to exhibit respect of others' professional disciplinary contribution. In theory, interdisciplinary research confronts and seeks to deconstruct conventional disciplinary boundaries. However, undiscussability may undermine this conceptual ideal. As Whyte (1991b:98) defines, "social undiscussability involves participants' reluctance to get into topics that might prove personally embarrassing or likely to cause hard feelings. Structural undiscussability involves reluctance to broach topics that have been defined as out of order, according to the ground rules mutually agreed upon by the parties". Within the IWRAM project, both structural and social undiscussability appeared to manifest within interdisciplinary discussions. Firstly, the assignation of component-based responsibilities reinforced a reductionist epistemology and provided a structural basis for different researchers to be validated within different spheres. Thus, the biophysical researchers were expected to comment on biophysical matters, the sociocultural researchers were expected to comment on social concerns, and so on. This structural respect for others' disciplinary contributions appeared to discourage the broaching of potential disciplinary biases by researchers from outside that discipline. Social undiscussability then became implicated through the interplay of professional and personal respect. Researchers appeared more willing to discuss others' potential disciplinary biases during individual interviews. Consequently, the strategy of interviewing researchers separately, collating responses, and then engaging in a facilitated group dialogue was more successful in highlighting and discussing disciplinary biases.

7.3 Shaping the DSS: Contributing factors

Even though no physical construction of the DSS had taken place by the time my observations of and involvement with the IWRAM project ceased, several factors had already introduced biases in terms of the likely form and content of the DSS. Firstly, integrating different professional and strategic interests together into a project of mutual interest shaped the initial focus of the project and therefore of the DSS. For example, there was a widespread expectation from the outset that IHACRES, a model which the Australian project leader had developed and worked extensively with during his professional career, would be likely to be incorporated within the modelling system of the DSS. Similarly, there was an expectation from the outset that, given the Australian sociocultural leader's research interests, efforts would be made to promote a participatory approach.

As the project progressed, emergent interests and commitments, such as institution-building, motivated either reconstruction or reinforcement of conceptual and methodological dimensions of the project and the DSS. In particular, the participation of new team members introduced a new suite of research interests, including favoured techniques, models and theory. For example, the familiarity of the appointed Australian economic component leader with the Extend simulation system influenced the use of that system among the Australian team in further conceptual development of the DSS. In parallel, the Thai DSS leader proceeded with the use of a simulation system based on the Fortran computing language, which he had used previously, arguing that as he would be the one who would eventually have to maintain the DSS, he wanted the DSS to incorporate a simulation system which he would be more able to apply, maintain and communicate.

Secondly, the IWRAM experience has demonstrated that within the present Australian political era, which is placing increasing pressures on academia to attract external funding, the influence of funding bodies on research practice should not be underestimated. Within the IWRAM project, the funding discourse, transmitted via guidelines, objectives, recommendations and accounting procedures demanded that prior to the official commencement of the project, decisions had to be made as to the scope, objectives, and methods of the project, who would be involved, what types of hardware, software and data was likely to be incorporated, and how the budget would be allocated. These decisions placed further bounds on what could be researched and how that research could be conducted, and thereby on the nature of the DSS. The need to specify objectives, methodology and so on before the funding application would be approved also placed significant constraints on the extent to which potential stakeholder users could participate in the initial conceptual development of the DSS, see Figure 7.3. Researchers must frame a proposed project in detail before they receive funds, and during this period, they must rely on a self-funded participation programme if they wish to engage in collaborative design. Thus, as Carr and Wilkinson (1997:742) observe, "It is very difficult in current funding cycles to have collaborative design in research because of time-lags, expense of consultation with local groups, and it is horrendously complex given the rigidities in funding cycles". In this manner, funding processes act to reinforce development biases in terms of who is empowered to participate in initial formulation of a DSS development project, and thus whose perspectives are incorporated in the conceptual framing of the DSS. Consequently, as with previous highland development projects, highland villagers did not participate substantially in the original formulation of the IWRAM project which reflected bureaucratic and academic perspectives of the decision-making environment.

Once the project officially commenced, the funding procedures continued to influence the conduct of research via the prospect of performance reviews and staggered funding which exerted pressure on the researchers to achieve "quick runs on the board". Research activities likely to achieve rapid outcomes were thus accorded prominence. Matters perceived to be outside or peripheral to the core funded proposal, such as issues of practice pertinent to a longer timeframe, were at best relegated to secondary priority. Supporting this analysis, some participants intimated that while reflection on potential biases and other use-related issues was an interesting exercise, it ran counter to "getting on with the task".

Given the influence of the funding process, whoever takes primary ownership of preparation of the funding application for the project plays a critical role in shaping the DSS, even though this may not be obvious at the time. During preparation of the Australian teams' funding proposal, many people were eager to be involved by name, but few were enthusiastic about expending substantial amounts of time contributing to the proposal. The result was that decisions were clustered around those individuals who were willing to take the most active ownership, and that the project agenda, focus and methodology was inevitably shaped by their interests. In terms of primary ownership, the CRES hydrologist, who tended towards a DSS-for-research stance, assumed (and perhaps was partially thrust into) this role through apathy, absence and conflicting professional commitments of other personnel, as well as his own interests.

The IWRAM case study illustrated that features of the decision-making environment of the Northern highlands of Thailand may also necessitate research decisions which serve to shape the DSS. For example, the Thai sociocultural team decided to exclude from their study one of the ethnic groups, the Lisu, in one of the focal catchments, because the Lisu

village was thought to be involved in heroin refinement and trafficking. As well as the village presenting a dangerous situation for field research assistants to work in, there were doubts over the likely validity of interview data, which, if incorporated in the DSS, would have led to distortions in knowledge. Thus, the village was excluded from the study. As different ethnic groups tend to be associated with different patterns of land use, the exclusion of key groups amounts to an instance of bias in terms of 'absence of knowledge' which may have implications for the representativeness and future extrapolation of the DSS. It should be noted that biases due to catchment selection criteria were compounded when limited financial and personnel resources lead the Thai team to select focal catchments that were the most well-documented but had the least ethnic diversity.

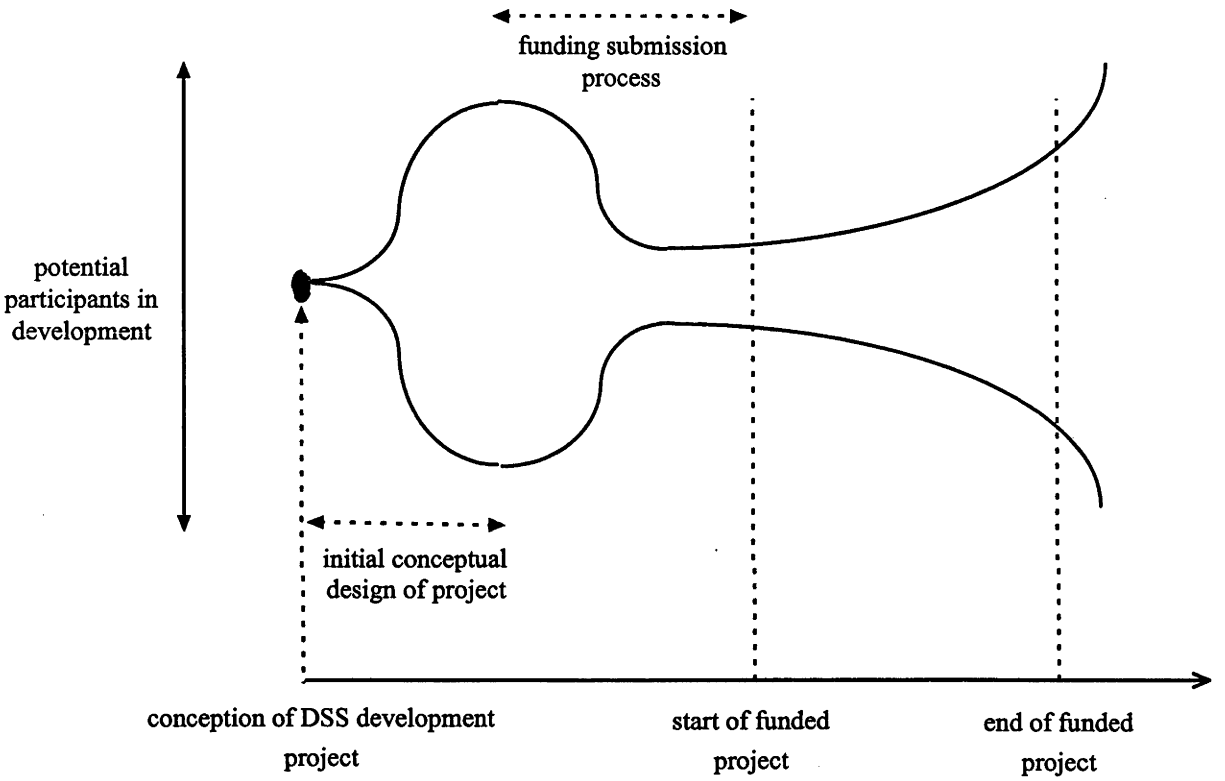


Figure 7-3 Potential participation in DSS development

Within the Australian biophysical team, who were undertaking precipitation-runoff modelling, the (un)availability of data introduced a potential bias in terms of absences in knowledge. Fragmentation and rivalry between government departments and other data collection agencies had led to a tradition of non-sharing of information. The biophysical team encountered great difficulties in acquiring access to data, and in some cases, were denied access, leading to absences in knowledge. The quality of data also provided a key source of potential bias due to absences and distortions in knowledge. Initial examination of the data suggested possible data errors. For example, during the dry season, when it would tend not to rain for many days, it was expected that streamflow data would illustrate a gradual incremental decline. However, the data showed that the same level was recorded each day for a week, then would suddenly step down to a lower level which was recorded each day for the following week, and so on. It was thought that the villager or public servant hired to check the stream flow gauge probably visited the site once a week, and

then would write down that level for the whole week[46]. The potential for other distortions in streamflow data was revealed in the catchment of Wat Chan, where streamflow readings did not register for the first few rainfall events of the wet season. At first, it was hypothesised that the dry streambed was soaking up the initial rain, leading to zero streamflow. However, a site visit to Wat Chan revealed that the streamflow gauge was removed during the dry season to prevent it being stolen or vandalised and was not replaced until after a couple of downpours had signalled the commencement of the rainy season. Doubts also arose regarding the accuracy of precipitation data as it was unclear what instruments were used to measure the rainfall, whether the data was recorded every day, or whether the data was recorded at the same time each day. The latter factor was significant because if the rain gauge was read at different times during the day, then rainfall events could be artificially large or small depending on whether the gauge was read later or sooner. In fitting the data, the precipitation-runoff model IHACRES tries to ensure that the largest rainfall events are modelled correctly. Thus, if apparent large events are actually over-estimated, uncertainty may be compounded. Although the modellers have developed rigorous techniques and conventions to deal with dubious data, such as presuming the first streamflow reading from each step of the streamflow data is correct and altering the intermediary readings to fit a linear curve, the potential for distortions and absences in knowledge remain.

Several factors during the course of the project have resulted in the Australian team assuming increasing control over the research process, thereby increasing their relative influence in shaping the DSS. Firstly, the economic recession which Thailand began to experience in 1997 compounded the resource difficulties facing the Thai team, who had been unsuccessful in attracting funding. As a result, some of the Thai academic collaborators withdrew from the project, and were replaced by public servants. In response to the diminished capacity of the Thai team, the Australian researchers assumed greater responsibility for research tasks where practicable. In some cases, the reduced capacity led to research tasks being simplified. For example, in the sociocultural component, the withdrawal of the entire original Thai sociocultural team, amounting to the loss of field research capacity for participatory research, lead to many participatory aspects of the project being simplified dramatically.

Differences between the way in which the Thais and Australians approach collaborative research also seem to have contributed to the Australian team taking increasing ownership of the research process. The Australian collaborators work more rapidly according to a Western model of efficiency; Thais work to an alternate model which to the Australians appeared slower and more protracted. In part, the interaction necessary for efficient project management amongst the Thai team was impeded because the collaborators were scattered amongst several government offices and university campuses in Bangkok and Chiang Mai, in contrast with the Australian team who were co-located in the same building. Furthermore, while the Australian team was funded to hire several additional researchers dedicated entirely to the IWRAM project, the funding problems encountered by the Thai team necessitated a reliance on existing team members, many of whom were unable to accord sole or even first priority to the IWRAM project because of their other professional

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[46] The occurrence of stepped streamflow data is a common data problem encountered during hydrologic modelling in both developing and developed countries. In addition to human data recorders occasionally missing a daily reading, particularly on public holidays, digital recorders also sometimes display steps, suggesting a possible instrumentation bias.

commitments. As the Thais tended to concentrate on practice and the Australians on product, the preceding events have contributed to the DSS-as-research perspective gaining primacy in the development of the DSS.

Different researchers' personal modes of communication and interaction was another important factor in terms of different researchers' relative influence in shaping DSS development. Observations of Australian team meetings suggest that a vocal, assertive and factual style tends to override a quieter or a more conciliatory approach. Supporting this analysis, one Australian researcher, a DSS-for-use advocate, remarked that she felt her influence being eroded because she favoured a less aggressive style than others. Within both Thai and Australian teams, males tended to be more dominant than females, however, given the small number of researchers involved, there was insufficient evidence to conclude that gender rather than personalities was involved. Within joint Thai-Australian meetings, the Australians tended to play a greater role than the Thais in discussions, thereby reinforcing the predominance of the Australian framing of decision support in development of the IWRAM DSS. The tendency for the Thais' to make fewer substantive comments during group dialogues than the Australians may possibly be due to the meetings being conducted in English, or to the cultural style of meeting procedures. The latter interpretation is supported by comments made by some of the Thai collaborators and my observations of joint team meetings (see Section 6.6). Some Thai studies literature suggests that differences in Thai and Western ideals of interaction, implicated in differences in the ritualistic dimensions of meetings, often introduces tensions in cross-cultural collaborative development practice (cf Hinton 1992, Demaine 1986:110).

7.4 Effective reorientation? Assessing the frameworks

Given the limited time period of this thesis, the following evaluation of the theoretical and analytical frameworks should be viewed as preliminary rather than conclusive. None-the-less, analysis of the IWRAM case study provides insight into the utility of the frameworks in revealing convergences and divergences in framing, and in promoting critical, collaborative learning. Complementing the case study narrative, the following discussion reflects my interpretations based on the totality of my observations of and interaction with the IWRAM case study.

Firstly, the IWRAM case study suggested that the discursive interrogation of biases was useful in highlighting tensions of framing, allowing negotiation over the degree to which different framings should shape or manifest within the DSS. During the interviews with Thai researchers, it emerged that perceived divergences in perspective tended not to be discussed openly amongst participants. However, many interviewees treated the interview as an indirect conduit to expose and air these divergences more widely. The analytical framework thus provided an opportunity to reveal tensions, and a focus for constructive debate over reconciling alternate framings.

Analysis of the analytical framework dialogues in the context of the critical history of development of the IWRAM DSS highlighted some inconsistency between researchers' espoused theories and theories-in-practice. For example, DSS-for-research advocates tended to advocate participatory ideology, while their practice routinely undermined broad participation by failing to support adequate resourcing and by moving forward in the research plan without waiting for participatory inputs. Probing within the dialogues was useful in pointing to the systemic commitments which pressured and promoted enactment of the theory-in-use rather than the espoused theory. This reinforces the value in ensuring

that the conceptual underpinnings of the analytical framework remain at the forefront, rather than the form, and that the methodology of using the framework is flexible. Thus, the framework questions should not be regarded as either rigid or sufficient, since further probing may be necessary to encourage dialogue and challenge assumptions.

The critical history of the IWRAM project illustrated that apparent broad convergence may obscure subtle differences in framing. In particular, within the Australian trial, the presumption of close convergence at the beginning of Part A of the analytical framework was increasingly challenged as the interrogation of biases proceeded. For example, while both the Australian project leader and Australian DSS leader framed the DSS as a computer-based tool integrating models and GIS, the DSS leader construed DSS as necessarily supporting particular decision-making processes, while the project leader cast the DSS as a more generic technical and transferable system. The case study also illustrated that convergence at an initial stage may develop into divergence through changes in framing over time. As O'Neill (1998) suggests "In social settings where descriptions of concepts change over time, the participants may not realise that their meanings are no longer cohesive". Thus, while the Australian researchers all framed DSS as a computer-based tool at the beginning of Part A, by the conclusion of Part B, an alternate framing of DSS as process had emerged. This finding reinforces the value of iterative use of the analytical framework to interrogate emerging incompatibilities in framing, and manage emerging biases.

The theoretical and analytical frameworks had variable success in promoting long-term critical learning within the project. Those participants most responsive to using the frameworks to catalyse critical reflection on individual and group biases were those who tended towards a DSS-for-practice stance, including the majority of the Thai team. Some Thai studies literature suggests that hierarchical tradition in Thailand would discourage critical thinking (Hirsch 1990, Gohlert 1991). However, with only a few exceptions, both government and academics challenged their own ignorance and invoked stories of political conflict to articulate alternate constructions of problems and problem-solving. Within the Australian team, most participants gained an increased conceptual awareness of potential biases, and some actively carried critical reflection of bias into their research practice. However, it appeared that other participants were tolerating rather than actively engaging in critical discussion of biases.

Some participants seemed to encounter difficulties in accepting the notion that being inwardly critical could be a legitimate intellectual activity. They perceived critical thinking and dialogue to be negative and non-constructive, and an impediment to efficiency. They also had difficulties in reconciling my role as a non-directive catalyst and facilitator, and often expressed a preference that I advise them of how I thought they should modify practice to recognise potential biases that I had identified. These participants' negative sentiments about engaging in critical, reflexive dialogue appeared to deepen when systemic constraints, particularly pressures to work at a rapid pace to produce frequent tangible outputs, were heightened. A short-term efficiency instead of long-term effectiveness orientation has been recognised by Zuber-Skerritt (1996) as one of the main barriers to action research. Supporting the IWRAM experience, Zuber-Skerritt (1996:91) suggests that the desire to want to 'get on with the job' to achieve short-term results in minimum time discourages spending time on reflection, team building and discussion. Zuber-Skerritt (1996:91) also notes that emphasis on operational rather than strategic organisational issues presents a further barrier to action research, as it may lead to

resentment at exploring philosophical assumptions and strategic directions. An operational focus may partially account for some IWRAM participants' disinterest in critical reflection and dialogue on bias. As recognised in Chapter 4, the potential of the framework to catalyse learning is inevitably constrained by the extent to which a participant is open to learning occurring. However, at a minimum, the framework requires participants to explicitly confront certain questions and articulate positions which would otherwise remain unvoiced.

The IWRAM case study suggests another barrier to collaborative critical learning may stem from perceptions of professional vulnerability if ignorance is admitted to in the presence of fellow researchers. For example, some participants would be open about spheres of personal ignorance during discussions with me, a student, but would refrain from raising these potential biases during the group dialogues, and further, would sometimes portray themselves as completely knowledgable about these spheres.

Action learning was further constrained since research tasks tended not to conform to a model of habitual, repeated practice. Instead, development of the DSS entailed a linear sequence of one-off tasks, directed towards achievement of project goals. Consequently, unless researchers were involved in parallel DSS development projects, they would be unlikely to engage in some development tasks until the group had moved onto their next DSS development project. Furthermore, monitoring and reflecting on the effects of DSS development actions, in order to adapt practice, is not a short term exercise. These timing issues illustrate that some tensions arise when an action learning-by-doing approach is used in future-oriented, anticipatory practice.

Where learning did occur, in terms of greater awareness of and responses to bias throughout the IWRAM project, situated learning theory prompted an expectation that this learning would reconstitute IWRAM DSS development practice, and that beyond my interaction with the project, learning would flow through to newcomers through peripheral participation in the IWRAM community of practice. However, this expectation did not materialise. Firstly, the new Australian appointees did not act as much like apprentices as presumed by peripheral participation theory (Lave and Wenger 1991). Rather than gradually internalising the norms and negotiated approach of the existing IWRAM team, the new staff were keen to establish their academic independence and credibility. They viewed the project proposal, and the three years of negotiations which had led to the formation of that proposal, as past history. They construed the DSS as a technical, software-based product and were reluctant to integrate a process-oriented framing. As the new staff's contracts were bound to the funded project timeframe, they faced magnified pressures to deliver a product at the end of three years, and to dismiss perceived non-core activities such as critical reflection on biases and other practice-related issues. They were also engaged full-time on the DSS development, unlike the existing researchers for whom the IWRAM project was one amongst a number of academic responsibilities. Consequently, they assumed greater independent ownership over DSS development, and were initially less interested in accommodating the outcomes of the original researchers' discursive interrogation of biases, than anticipated according to peripheral participation theory. However, over time, some of the new staff did express an interest in reading the critical history of the IWRAM project (Chapter 6) to inform continuing conflicts within the whole team regarding DSS-as-software vs DSS-as-product. This illustrates the potential of a textual record of even a single, non-iterative interrogation of bias to facilitate post-facto evaluation and inform backward learning.

It should be reiterated that the new staff commenced their work with the IWRAM project towards the conclusion of my case study, and thus did not participate in bias dialogues. One of the original researchers, who maintained a personal interest in iteratively reflecting on bias, suggested that the withdrawal from the project of not only myself but also a number of the original researchers who were responsive to the use of the frameworks, as well as the part-time status of others who had participated in the interrogation of biases, impeded the potential for learning to flow through to the newcomers. This suggests that long-term learning via iterative use of the frameworks requires a champion to enthuse and catalyse others to participate.

The process of using the analytical framework with the IWRAM project suggested several modifications to the original framework to improve its format, practicality and relevance for that specific case. Firstly, to facilitate comparison of participants' modes of framing, a section was inserted to locate, firstly, the role of participants within DSS development and, secondly, their initial framing of the DSS. Secondly, where developers joined the IWRAM team at a later stage, and thus were not involved in the original conceptual development, it was more useful in terms of building a picture of that participants' construing to inquire about the perceived purpose of the DSS, rather than how it was initiated. However, during the group dialogues, it remained useful to revisit earlier responses regarding the initiation of the DSS both to apprise newcomers of this dimension of the critical history and to inform negotiation of the shared group vision for the DSS. A number of semantic modifications arose as more appropriate language emerged to phrase certain questions. For example, the term 'decision problem', adopted from the DSS literature, was replaced by 'the decision', as many participants not from a DSS background argued that they did not necessarily construe decisions as problems. Other modifications were made to improve the logical flow of questioning. For example, while uncertainties and assumptions relate to embedded assumptions, it proved more useful to interrogate these issues within the context of communication (access) biases. This highlights the interconnections between different questions, and the value in viewing the framework as a flexible heuristic tool rather than as a rigid methodology. Different elements of the framework complemented and reinforced each other in the gradual revelation of the narrative of decision support and bias for the IWRAM project. Table 7.4 presents the adapted framework.

7.5 Conclusion

Tensions of framing decision support within the IWRAM project illustrated that developers' different motives for being involved in DSS development, their differing construing of environmental problems, problem solving and the decision-making environment may shape and thereby bias the form and/or content of a DSS in particular ways. Systemic professional pressures, ideological commitments, and disciplinarity are among the factors which served to promote one framing over another in the construction of the IWRAM DSS.

Evaluation of the proposed reorientation of DSS development in light of the experience of the IWRAM case study has demonstrated that the theory informing the reorientation held together cogently, and has attested to the practical worth and relevance of the analytical framework for interrogating bias. As well as assisting in highlighting alternate framings, the analytical framework served to promote critical learning amongst some of the IWRAM participants. The case study also revealed several barriers which discourage collaborative critical learning via the interrogation of biases, including an efficiency orientation,

professional vulnerability and the time horizons involved in DSS development. In particular, the case study also suggests that an interrogation of bias emerges as less relevant if developers are primarily interested in development of a technical DSS-for-research, rather than a DSS for practice.

Table 7-4 Altered framework for anticipating and reflecting on bias in DSS

Locating the participant

What role will you have in developing the DSS?

Can you describe what you think the DSS should be like?

A: Background

A1. Why was this development of DSS initiated?/What is the purpose of the DSS?

A2. What decision(s) do you think the DSS should support?

A3. Who are the stakeholders to this decision?

A4. Are there existing decision-making processes relevant to this decision?.

A5. Who are the intended users (direct and indirect) of the DSS?

A6. What benefits do you think different users will get from using the DSS?

A7. Will the DSS be used in conjunction with any other decision-making tools or processes?

A8. What are the criteria for success of the DSS?

B: Embedded bias

B1. Describe the people who you think should be involved in development of the DSS. Why, when and how should they be involved?

B2. Describe those stakeholders who will not be involved in the development of the DSS. Why won't they be involved?

B3. How do you think different stakeholders' views need to be considered during the design or construction of the DSS?

B4. Who do you think should frame the decision in the DSS?

B5. How do you think the decision should be framed in the DSS?

B6. Can you think of any alternate ways of framing the decision?

B7. Describe the hardware, software, models and data which you think should be incorporated in the DSS. Why should they be incorporated? How will they be integrated?

B8. Have any hardware, software, models or data set options previously under consideration been rejected? If so, why?

B9. How might the decision, or the decision environment, change over time?

B10. How well do you think the DSS will be able to respond to these changes?

C: Biased access

C1. What outputs will the DSS have?

C2. How should the output of the DSS be presented to the different direct and indirect users?

C3. What uncertainties and assumptions can you think of that relate to the DSS?

C4. Should uncertainties and assumptions be communicated to different users? How?

C5. What are the likely up-front and running costs of the system? Who will bear the costs?

C6. Do you think any of the direct users will have difficulty accessing the DSS because of: the geographical structure of the DSS; the financial cost of using the DSS; and/or the literacy required to use the DSS; any other reason?

C7. Do you think any of the indirect users will have difficulty accessing the information output of the DSS because of: the geographical structure of the information; the financial cost of the information; or the literacy required to access the information; any other reason?

C8. How will the DSS articulate with existing or intended policymaking processes and institutions?

C9. In the light of (A5) and (C4,5,6), is it likely that use of the DSS will increase the participation of any of the stakeholders in environmental decision-making?

C10. In the light of (A5) and (C2,4,5,6), is there a risk that use of the DSS will decrease the participation of any of the stakeholders in environmental decision-making?

Iterative summary

- At this point, what do you consider to be the major advantages in using DSS in this decision-making environment??
- At this point, what do you consider to be the major problems with using DSS in this decision-making environment??
- What steps could you take to minimise or manage these problems?

Conclusions and discussion

State- and foreign-sponsored highland development projects have encouraged intensification of agriculture and greater incorporation into the market economy. In the top picture, a highland villager has loaded up his pick-up truck to sell his crops at the Chiang Mai markets. The lower picture shows a tin shed storing his pesticides and fertilisers, which have accompanied the agricultural intensification and introduced new environmental problems.

8. Conclusions and discussion

This chapter consolidates and reflects on the contributions of this thesis. Implications of the thesis for the development of decision support systems and for the practice of integrated research are advanced. Limitations of the research are canvassed, and future research directions are suggested.

8.1 Environmental decision support: Anticipating bias

Rhetorical justification of environmental DSS, and DSS development and extension ethos, have tended to stem from and be embedded within a positivist paradigm. However, influenced by interdisciplinary critical analyses, positivist assumptions of the objectivity and privilege of science are encountering widespread and mounting scepticism. The central concern of this thesis has been the effectiveness of DSS to assist Integrated Environmental Management within a post-positivist paradigm that recognises the constructedness of knowledge and the partiality of science. The contributions of this thesis are summarised in Box 8.1.

- Critique of conventional rationale for environmental DSS
- Development of taxonomy of bias relevant to environmental DSS
- Development of theoretical framework to underpin reflexive, precautionary DSS development
- Development of practical analytical framework to guide an interrogation of bias
- Through grounded case study, trial and improvement of theoretical and analytical frameworks in practice
- Contribution to methodological literature through testing of action research and integrated research theory

Box 8-1 Contributions of this thesis to theory, method and practice

Drawing on new paradigm alternatives to positivist inquiry, Chapter 2 constructed an innovative methodology which emphasised transparency, reflexivity, critical thinking and methodological pluralism. Throughout this thesis, informing constructs have been integrated from multiple bodies of theory, many of which have not previously received attention within the DSS field. This transdisciplinary approach has enabled a new perspective on DSS development. In particular, by framing DSS development as a process of social negotiation, rather than as a rational, objective, technical exercise, the political dimensions of DSS development have been highlighted. Both the research methodology, and mode of presentation of this thesis, reflected an endeavour to promote consonance between the conceptual concerns of the thesis, including the constructedness of knowledge, and my own academic practice. The thesis, as process and product, thus illustrates reflexivity in practice. The preceding methodological dimensions set this thesis apart from any previous critiques of

environmental DSS. Hence, this research represents a considerable contribution to the emerging critical DSS literature.

Chapter 3 critiqued the conventional framing of environmental DSS as inherently objective, expert and efficient. Drawing on theory of the construction of knowledge, I argued that a DSS will reflect and validate the worldview of those who have input into or influence over the design or development of the DSS. Consequently, the potential arises for bias to be embedded within a DSS during its design and development so that the output of the DSS systematically favours or promotes one perspective over another. Sources of embedded biases in output include commitments, absences of knowledge, and distortions of knowledge. Since a DSS may constitute a discursive method for validating one perspective over another, biases in terms of access to the technology, or to the processes in which it is embedded, may introduce, reinforce or augment power inequities between stakeholders. Sources of biases in access include the geographical, financial considerations, literacy, and political considerations. Identified sources of bias were synthesised in a taxonomy of bias.

Challenging the purported expertise of DSS, I drew on contemporary development, adaptive management and other literature to argue that, like knowledge, interpretations of expertise are also multiple and socially constructed. So long as the development of DSS remains in the hands of an elite technical or epistemic group, according to the conventional mode, the knowledge embodied within the system, the system structure and the output of the system will tend to conform to and reinforce the biases and ignorance of this group. Democratisation of expertise advocates opening the development process to a wider cross-section of stakeholders to assist in managing for bias and ignorance. However, participatory approaches are no methodological panacea to rid DSS development of bias, as they too are inherently political processes in which validation of the structure, form and content of the DSS is enmeshed in systems of power. Consequently, regardless of the DSS development approach adopted, a commitment to equity and transparency dimensions of the sustainability paradigm demands critical appraisal of the systems of power engaged during development, and their implications for bias. Chapter 3 closed by arguing that the interrogation of potential biases during DSS development is also imperative for effective - and efficient - delivery of decision support. While every DSS will be associated with some form of partiality and bias, the key question is whether the biases associated with a particular DSS are significant in light of stakeholders' grounded concerns. Thus, processes are necessary which facilitate a situated interrogation and management of potential biases associated with a particular DSS.

Chapter 4 articulated a theoretical and an analytical framework to guide a reorientation of DSS development processes which would better respond to the constructedness of DSS and the potential for bias. Central to this reorientation was the reconstitution of DSS development as reflexive, precautionary practice. A cyclical, discursive approach, based on action learning and critical theory, was advocated to guide critical inquiry into, reflection on, and analysis of the interactions between developers' practice, development biases and the decision-making environment. By enhancing self-awareness of individual and shared biases, reflexive

DSS practice may promote individual learning. As individuals probe and debate competing framings of decision support in concert, a mutual vision for the DSS may be negotiated, and collaborative learning may emerge. Through communication of the critical history of DSS development, including the discursive interrogation of biases, post-facto learning is also promoted. Drawing on the taxonomy of bias, an analytical framework was proposed to facilitate an interrogation of bias by developers and users of DSS to enable the anticipation, avoidance and minimisation, both prior to and during DSS design and development, of potential biases likely to interact transformatively with the decision-making environment.

To inform and ground the theoretically-derived frameworks, they were used to guide an interrogation of bias in a joint Australian-Thai research project which was developing a DSS to assist Integrated Water Resources Assessment and Management (IWRAM) in the highlands of Northern Thailand. To locate the IWRAM project, Chapter 5 outlined the geographic, cultural and political decision-making environment of the Highlands of Northern Thailand. Drawing on a narrative of the highland environmental history as well as a discussion of the political culture of highland decision-making, tensions were highlighted which underlie interpretations of and approaches to highland decision support. Rather than presenting as a technical, politically benign problem amenable to rational optimisation, highland environmental decision-making, including framing of 'the problem' and approaches to solutions, emerged as a political battle-ground in which stakeholders seek to acquire legitimacy in claims over contested spaces and resources. Through foreshadowing potential biases, DSS was revealed as a potential discursive tool in these battles. Amongst other factors, centralisation, patriarchal rule, a tradition of bureaucratic elites controlling the expertise and tools of power, historic marginalisation of highland people, the remoteness of highland villages, widespread illiteracy and persistent low incomes within highland villages pointed to the potential for the IWRAM DSS to be biased in favour of a government framing of decision support and against the perspective of highland people. Chapter 5 also illustrated that awareness of the decision-making environment may heighten sensitivity to potential biases. Chapter 5 concluded that for the IWRAM project, a challenge was whether and how the processes of developing and implementing a DSS for the Northern highlands could be constructed to minimise and avoid potential biases.

Chapters 6 and 7 described and analysed the discursive interrogation of biases by collaborators in the IWRAM project. The narrative of development of the IWRAM DSS, presented in Chapter 6, illustrated that the process of framing and shaping the DSS has been enmeshed within networks of sociopolitical and personal commitments. Professional interests and aspirations, strategic institutional building, ethical concerns, disciplinary commitments to methodology, pressures to satisfy funding bodies, aspirations for furthering sociopolitical empowerment, and normative constructions of the highland decision-making environment were among the factors which appeared to contribute to different participants' framings of the nature and role of decision support.

The IWRAM case study also illustrated that the interpretive flexibility of the term 'decision support' underlies key tensions and dilemmas within environmental

decision support development, practice and discourse. The discursive interrogation of biases was useful in highlighting tensions of framing, and providing a focus for constructive debate and negotiation over the degree to which different framings should shape or manifest within the DSS. The value of exploring and making more transparent alternate constructions of decision support, and the networks that shape those constructions, lies not in seeking to structurally manifest the most 'objective' nor most 'correct' construction. Instead, the value lies in revealing the role that sociopolitical spheres of influence play in shaping the nature and form of decision support, thus enabling 'effective' decision support to be assessed not only in the light of a specific decision-making environment, but also in the light of the specificities of the development environment. Consequently, management of bias is not a one-off exercise in discerning and applying the most bias-free method, but involves: firstly, continuous critical appraisal of both potential and emerging biases; and secondly, iterative adaptation of methods as the development community evaluates the compatibility of the DSS development approach with the needs of the decision-making environment in the light of the critical appraisal. Consequently, the questions listed in the analytical framework for interrogating bias should not be regarded as either rigid or sufficient. Instead, the conceptual underpinnings of the framework should remain at the forefront, rather than the analytical form, and the methodology of using the framework should be modified as required to encourage dialogue and challenge assumptions.

The IWRAM case study raised the potential for the theoretical critical and collaborative learning concepts underlying the analytical framework to inform a deconstruction of disciplinary biases and catalyse negotiation of an integrated framing of decision support to allow the joint enterprise to progress. Furthermore, the experience of the IWRAM case study suggested that the analytical framework for interrogating bias may be modified and reconstructed as a tool for exposing disciplinary politics and biases in any interdisciplinary project, not only those focussing on developing a DSS.

The narrative of the IWRAM case study illustrated that use of the proposed frameworks may catalyse individual, situated learning in practice. This was evidenced within both Thai and Australian teams by participants' evolving framing of decision support as well as their increased conceptual awareness of potential biases. It also illustrated the potential of a textual record of even a single, non-iterative interrogation of bias to facilitate post-facto evaluation and inform backward learning. Of those IWRAM researchers who participated in the interrogation of biases, only a few regarded the process as neither constructive nor catalytic of learning. In part due to the influential role of these latter participants in shaping the DSS, and also because of the withdrawal from the project of some of the participants who were most receptive to exploring bias, the interrogation of biases has to date had limited impact on the IWRAM DSS. However, at the point of submission of this thesis, interest in considering the issues raised during my research has been reignited within both the Thai and Australian teams.

The IWRAM case study illustrated that potential of the framework to catalyse learning is inevitably constrained by the extent to which a participant is open to

learning. However, at a minimum, the framework requires participants to explicitly confront certain questions and articulate positions which would otherwise remain unvoiced. The case study also suggested that the extent to which precautionary DSS development is embraced does not rest solely with predilection of individual participants, but is instead mediated by systemic sociocultural and political pressures. In particular, established ideologies and systems of power, manifested in the established discourse, practice and organisation of research and funding communities, reinforce and entrench conventional practice, and dissuade DSS developers from engaging in reflexive, precautionary practice.

8.2 Implications for DSS development

As evidenced throughout Chapter 3, a new paradigm is tentatively emerging within environmental DSS literature which attends to some of the issues which flow from a critical examination of the conventional paradigm of DSS development. For example, a constructive and substantive role for DSS is supported so long as the conventional preoccupation with providing optimal solutions to environmental problems is displaced by an emphasis on supporting an evolutionary learning process. The fledgling paradigm also prompts DSS developers to make greater efforts to encourage participation by intended end-users within the development process to promote increased contextual relevance. No longer are users restricted to technical analysts; instead, DSS engages multiple stakeholders with differing needs and competences. By drawing on broad sociopolitical bodies of theory, this thesis has extended the concepts of learning, dialogue, and user participation in DSS development beyond their embryonic and cursory treatment within the emerging DSS literature. In so doing, this thesis has revealed tensions which underlie a learning-oriented, dialogic, participatory approach to environmental decision support, and which demand consideration if the DSS development community is to confront the challenge of effectively supporting integrated environmental management.

Firstly, this thesis suggests that DSS development may provide an arena for integration amongst multiple environmental perspectives. Dialogue amongst the different participants in DSS development may highlight convergence of vision and understanding about the joint enterprise (the DSS) and reinforce a mutually agreed trajectory for future development. Dialogue may also expose divergences and create space for debate about alternate framings of decision support, thus enabling negotiation amongst participants as to the appropriate framing of the DSS given the specificities of the decision-making environment. However, this thesis has also illustrated that effective dialogue may be constrained by a number of systemic pressures endemic within the DSS development environment, not least the mounting pressures on researchers to move further towards professionalism and profitable science. These pressures are unlikely to subside in the short or medium term as both Australian and Thai governments continue to extend their application of economic rationalist ideology within the research sphere, with no indication of imminent abatement. Against this background, there is a need to examine the pressures experienced by DSS developers, to assess the interplay between these pressures and a dialogic, learning approach, and to reconcile the need to work within the prevailing

political decision-making environment with critical concerns about the (in)effectiveness of conventional decision support. In effecting this reconciliation, this thesis suggests that, in particular, the operating procedures of institutions which fund DSS development should be attended to. For example, it may prove useful for funding institutions (such as ACIAR in the IWRAM case analysed here) to incorporate a DSS feasibility stage in which, prior to in-depth specification of technical details of the project, those proposing development of a DSS receive a small amount of funds to assess whether a DSS is likely to be more appropriate, useful and effective in the relevant decision-making environment than any other decision-making mechanism, and if so, what sort of DSS would be appropriate. Incorporation of such a stage may enable greater participation of the intended users in the initial conceptual stages, assisting in managing for bias and guarding against ineffective decision support.

Given the systemic pressures dissuading developers from engaging in dialogue about bias, steps may also need to be taken to institutionalise dialogic learning, including validating and resourcing a champion to enthuse and catalyse others to participate.

A move towards product-driven and efficiency-conscious professional science also points against the viability of the fluid developer-user entity (users as developers, developers as users) to which both participatory and discursive approaches aspire, and towards the notion that a DSS developer provides a finite service for a future consumer. Where developers' engagement with a DSS is spatially and temporally separate from users' engagement, continuity is impeded, and a greater likelihood arises for a loss of knowledge of the history of development decisions to occur. In this context, there is a need to develop means of binding the critical history of DSS development to a particular DSS to assist future transparency and learning. For example, within a DSS software package, an account of development could be embedded within the package, so that users could access it, and add to it if appropriate.

The IWRAM case study illustrated that the interpretive flexibility of the term 'DSS' may lead to confusion within the development process if participants who frame the DSS in alternate ways are not aware that they are referring to different constructs. In particular, with regard to the research/practice tension, confusion frequently arose as to the scope of the project. Research advocates, who framed the DSS as a technical computer-based product, maintained that DSS development should focus on software provision. They thus felt that process-oriented decision support was a separate aim of the IWRAM project, distinct from DSS development. Meanwhile, practice advocates, who framed the DSS as encompassing both software and non-software tools and processes, were often perplexed as to why the research advocates were not more willing to discuss process issues within the context of DSS development. During the Thai portion of the IWRAM case study, it emerged that greater clarity during dialogues was facilitated by distinguishing decision technology from decision support processes to indicate whether the discussion was strictly about a computer-based tool or more broadly about providing the most effective support to a particular decision-making environment. This indicates that if a precautionary approach to DSS development is adopted, care should be taken that the development community

gives adequate attention to and explicit acknowledgment of alternate framings before engaging in negotiation over the mutual vision of the DSS.

8.3 Implications for integrated research

The IWRAM case study illustrated that development of a DSS may facilitate integration by enabling different researchers to focus on a joint enterprise. It also illustrated that integration requires continuous interaction, as inconsistencies between disciplinary approaches (for instance, scales of analysis) may not be immediately obvious, but instead may emerge through time. This suggests that a commitment to integration necessitates both a common focus and a willingness to engage with other researchers repeatedly during pursuit of the joint enterprise, rather than merely at the outset of research.

During the IWRAM DSS development, it emerged that differing degrees of authority seemed to be accorded to different disciplines to contribute to the strategic goals and direction of the joint enterprise. It also emerged that the potential of either a technical or a process-oriented DSS to catalyse integration may be undermined or compromised if particular disciplines are not validated to contribute to that form of DSS. The analytical framework for interrogating bias proved useful to enhance the potential for any DSS to act as an integrative mechanism by explicitly revealing alternate framings of the DSS and the DSS development process, and by facilitating transparency of instances of disciplinary domination and bias. The experience of the IWRAM case study suggests that any attempt to engage in interdisciplinary research, regardless of whether a DSS is involved or not, may benefit from critical appraisal of the differential participation of researchers in the collaborative research, and of how this differential participation may be biasing the research product such that integration is undermined.

The IWRAM case study suggested that integrated research may be impeded if perceptions of professional vulnerability lead to a reluctance to admit ignorance in the presence of fellow researchers. The IWRAM case study also illustrated that dialogue directed at integration may be impeded by a researcher's desire to exhibit respect of others' professional disciplinary contribution. Hence, integration may be enhanced amongst a group of researchers if time is taken initially to engage in dialogue or activities that: firstly, promote mutual trust; and secondly, validate both admission of ignorance and critical challenges of others' perspectives as pivotal to effective integration.

8.4 Limitations of the research: Opportunities for future research

Given time limitations, the proposed taxonomy of bias is neither comprehensive nor complete, but instead reflects a distillation and synthesis of factors which emerged from the reviewed literature as significant for environmental DSS. In acknowledgment of my own biases (commitments and absences of knowledge), there is scope to develop the taxonomy further:

- For environmental DSS by expanding the review of environmental policy literature. Also, further review of public understanding of science literature may

yield useful insights into the interplay not only between access and bias, but also between *perceptions* of access and bias.

- For alternate DSS spheres of application. For example, with its industrial democracy underpinnings, Scandinavian participatory systems development literature may offer insights into organisational, production- and employment-related sources of bias.

Both the conceptual framework for reflexive, precautionary practice and the analytical framework for interrogating bias would benefit from further testing in other DSS development and decision-making environments. In particular, a key direction for future research is exploration of alternate methodologies of framework application which are more effective in promoting critical learning in the case of participants who construe the dialogue methodology as non-constructive. This type of research is particularly important given the increasing pressure on researchers to adopt an efficiency orientation. In this area of research, further exploration and trial of organisational learning methods which have already confronted the strategic learning-efficiency tension may be useful.

Largely because of the stage at which the IWRAM project was at, I have focussed in this thesis upon framing of decision support rather than upon production of the DSS or upon the DSS as product. Further research in these latter areas could include:

- Contrasting the material DSS with the discursive processes that generated and validated the embedded knowledge
- Exploring the interpretive flexibility of the material DSS as 'text' with respect to subsequent users or 'readers', and the political implications of alternate interpretations
- Through action research, developing processes by which users may interrogate, reveal and respond to biases post-facto development of a DSS.

As mentioned in my methodological limitations, this thesis has focused, in descending order of emphasis, on the Australian IWRAM collaborators, then Thai IWRAM collaborators, then other highland stakeholders. A fertile area for inquiry would involve eliciting in greater detail the constructions of the decision-making environment and decision support of highland stakeholders who have been un(der)represented in the IWRAM DSS development, to enable a more in-depth analysis of their convergence and divergence with constructions embedded in the DSS.

As a result of the development approach adopted by the IWRAM project, an opportunity was not afforded to engage a broader discursive community in the dialogues about potential bias. This thesis has thus focussed primarily on the different framings of decision support by collaborating researchers and public servants. However, as the IWRAM project proceeds, the participation of other stakeholders in development of the DSS is anticipated to increase. Over time, stakeholder 'users' are likely to have progressively more involvement in and ownership of DSS development, while the researchers are will have progressively less. A reinterrogation of bias as different stakeholders become involved would

illuminate convergence and divergence of framing amongst and between stakeholders, including different government agencies, different villages, NGOs and commercial interests. Broader participation of stakeholders in bias dialogues would also further test and inform the frameworks developed in this thesis as discursive tools for critical learning.

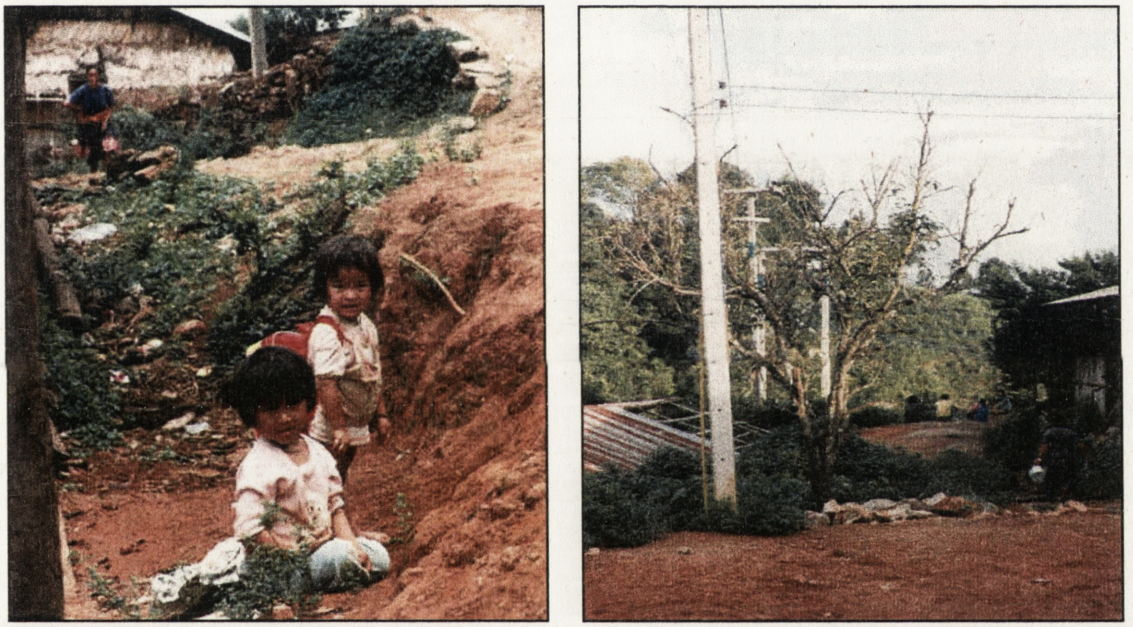
8.5 Reorienting environmental DSS: A critical future...

As the twentieth century draws to a close, two fundamental challenges facing humanity are the rapid expansion of computerisation, and the escalating ecological crisis. While the former has a key role to play in responding to the latter, this thesis argue that a blind faith in computer-based approaches may undermine an effective response to the environmental problematique. To avoid failure, this thesis suggests that the development and use of environmental DSS must be reoriented to embrace a reflexively critical approach. In other words, being critical is argued to be critical for the future of environmental DSS. This thesis further argued that central to a critical approach is recognition and management of potential biases associated with environmental DSS. I do not pretend to have developed within this thesis a penultimate response to bias. However, I have offered a nascent and substantial theoretical and practical step, which I hope will prompt expanded dialogue about the nature of bias and the opportunities for reflexive DSS practice.

At the outset of this thesis, the imperative for DSS was positioned within the information complexity of contemporary environmental management. However, the notion of bias suggests recasting the imperative, and the dilemma, of decision support in the context of social complexity. As humanity continues to grapple with decision-making for sustainability, I suggest that negotiation between competing social framings and a precautionary approach to bias will be increasingly imperative for collaborative action to promote a sustained future. The experience of the IWRAM case study suggests that in this endeavour, alternate non-computer-based approaches will need to be empowered alongside computer-based DSS, akin to the democratisation of expertise which allied 'local' and 'scientific' ways of knowing.

Although this thesis revealed several tensions between framings of decision support, I do not hold to an either/or dichotomy between different framings. Even in the case of the research versus practice tension, where key dimensions of framing clearly conflict, the choice is not necessarily one or the other. Instead, it is a matter of degree and emphasis, and of understanding better the implications of different commitments. Yet, discursive battles over alternate framings in order for one framing to win outright over another are likely to prevail within DSS development processes while integrative methodologies remain under-researched and under-communicated. As Norgaard (1994:141) notes, as yet, "we have little basis for even thinking about how disciplinary science, values, coordinating understanding, social structure, and collective action fit together". In this light, even though the process fell short of my hopes regarding collaborative interrogation, dialogue, learning and mutual negotiation, participants in the IWRAM project should be praised for being prepared to venture outside their research comfort zones and engage in a critical and transdisciplinary interrogation.

Appendices



Although some government departments have supported the forced removal of highland villages in the name of watershed protection, others have implicitly encouraged continued settlement by establishing schools and extending the electricity grid. These photos were taken in a village earmarked for relocation. In the right-hand photo, a group of villagers are smoking opium in the background.

Appendix 1 Questionnaires for Part A of Australian trial of frameworks

Framework for anticipating bias: Group discussion of Part A

30 May 1997 2:00pm

Name:.....

What are the main professional and personal skills which you think you bring to this project?

What are your main reasons for being involved in this project?

Framework for anticipating bias: Part A

A1. Why was this development of DSS initiated?

A2. What decision problem(s) is the DSS intended to support?

A3. How might this problem change over time?

A4. Who are the stakeholders to this problem?

A5. Characterise the existing policymaking processes relevant to this problem.

A6. Who are the intended users (direct and indirect) of the DSS?

A7. What benefits are these users expected to derive from use of the technology?

A8. In the light of (A2,A6 and A7), what are the information requirements of the technology?

A9. Will the DSS be applied in conjunction with any other policy mechanisms?

A10. What are the criteria for success of the DSS?

A11.At this point, what do you consider to be the major advantages in using DSS in this application?

A12.At this point, what do you consider to be the major problems with using DSS in this application?

A13.What steps could you take to minimise or manage these problems?

Framework for anticipating bias: Evaluation of Part A

Name:.....

1. Did you find any of the questions in Part A difficult to understand? If so, do you have any suggestions as to how they could be improved?

2. Did you think that the time spent reflecting on and responding to the questions in Part A was:

too short sufficient too long

3. Do you think that the process of reflecting on and responding to the questions in Part A has altered your attitudes towards DSS in any way?

4. Do you think that the process of reflecting on and responding to the questions in Part A has altered your vision of a Decision Support System for the ANU-RPF project in any way?

5. Which three questions do you think were most important or useful to have reflected on and responded to? Why do you consider them important or useful?

6. Which question(s) in Part A did you find most useful in terms of:

(Write question number (e.g. A1,A5 and A8). See facing page for a list of the numbered questions.)

a. indicating potential problems with the Decision Support System?

b. indicating different ways that people in the group had perceived the problem?

c. indicating different ways that people in the group were planning to approach the problem?

d. indicating different ways that people in the group had envisioned a Decision Support System?

e. helping to shape up your ideas about how the project component(s) you are involved in will relate to the Decision Support System?

f. helping to shape your ideas about the capacity in which you will be involved in development of the Decision Support System?

g. improving your understanding about the roles and responsibilities of other people/component teams in future development of the Decision Support System?

7. Do any elements of Part A of the framework (including both the questions and any problems which the framework has highlighted) seem useful enough to be used again during future development of the Decision Support System?

   If so, when do you think would be the most appropriate stage or time to revisit Part A of the framework (or selected questions in Part A)?

8. Do any elements of Part A of the framework (including both the questions and any problems which the framework has highlighted) seem useful enough to be incorporated in some way into the project research design? (e.g. as a discussion point at a project meeting, to monitor progress, to shape a milestone etc.)

9. Is there anything else you would like to add about the usefulness or relevance of (or improvements to) Part A of the framework?

Appendix 2 Interview guide for Thai trial of frameworks

Identification

I1 What role will you have in developing the DSS?

I2 Can you describe to me what you think the DSS should be like?

A: Background

F1. How do you see a DSS being useful in the Northern highlands of Thailand?

F2a. What disadvantages do you think introducing a DSS into the Northern highlands may bring?

F2b. What are the major problems you foresee in developing the DSS in this project?

A5. What do you think the criteria for success of the DSS should be?

A1. What decisions do you think the DSS in this project should support?

A2. Who do you think should be the (direct and indirect) users of the DSS?

A3. What benefits do you think different users will get from using the DSS?

X2. How do you think the DSS should relate to the participatory framework?

B: Embedded biases

B1. Can you describe to me the people who you think should be involved in development of the DSS. Why should they be involved? When should they be involved? How should they be involved?

B2. Which stakeholders probably won't be involved in development of the DSS? Why not?

B3. How do you think different stakeholders views need to be considered during the design and development of the DSS?

B4. Who do you think should frame the problem in the DSS?

B5. How should the decision problem be framed in the DSS?

B6. Can you think of any other ways of framing the problem?

B7. What types of data and models would you like to see incorporated in the DSS?

B8. How do you think the decision problem or decision environment will change over time?

B9. How well do you think the DSS will be able to respond to these changes?

C: Biases in access

C1. What outputs do you think the DSS should have?

C2. How should the output of the DSS be presented to the different direct and indirect users?

C3. What uncertainties and assumptions can you think of that relate to the DSS?

C4. How should uncertainties and assumptions be communicated to the different direct and indirect users?

C5. Do you think any of the direct users will have difficulty using the DSS because of:

- the geographical location of the system?, the financial cost of using the system?, the literacy required to use the system?

C6. Do you think any of the indirect users will have difficulty accessing the DSS because of:

- the geographical location of the system?, the financial cost of using the system?, the literacy required to use the system?

C7. Do you think that it is likely that the use of the DSS will increase the participation of any of the highland stakeholders in environmental decision-making?

C8. Do you think that it is likely that the use of the DSS will decrease the participation of any of the highland stakeholders in environmental decision-making?

Appendix 3 Agenda for Thai group dialogue, November 1997

Progressing the Decision Support System

Friday 14th November 2540 (1997)

Meeting agenda

1. USERS

- Identify and categorise all potential direct and indirect users.
- Identify mechanisms for engaging potential users and other stakeholders on an ongoing basis to guide development of DSS and to build up trust in the DSS by users.
- Who will be responsible for engaging users and other stakeholders as per above?

2. PARTICIPATORY FRAMEWORK

- How should the decision technology relate to the participatory framework?

3. FORM AND CONTENT OF THE DSS

- Identify opportunities to make the decision technology more equitable, participatory, transparent and flexible:

  Input multiple visions, options.

  Input multiple forms of data: sociocultural, biophysical, economic; scientific and indigenous.

  Scientific land use classification and indigenous land use classification.

  Plugged-in (replaceable) models

  Other opportunities

- At this point, what is the common vision of the form of the decision technology?

[1] A 'direct' user will interact (query, validate, feedback) directly with the technology; an 'indirect' user will interact (query, validate, feedback) with the information output of the technology via an alternate medium.

Appendix 4 Coding frame for analysis of transcripts

Code	*Theme*	*Related theme*
A	**CONSTRUING OF BIASES**	
Aa	*Access*	*Bu*
Aaa	*What is access/partipn?: Construing of access/partcpn*	
Aap	*Re how DSS may affect partipn/access*	
Aapo	*Sees opportunity for DSS to improve access/partcpn*	
Aapr	*Sees risk for DSS to decrease access/partcpn*	
Aaprt	*If DSS just technology - access restricted*	*Buzs*
	If top-down corner DSS	
	If DSS supplants other mechanisms	
Aag	*Re identifying and managing constraints on geographical access*	
Aaf	*Re identifying and managing constraints on financial access*	
Aac	*Re identifying and managing communication constraints/Literacy*	
Aacc	*Identifies communication /literacy constraints*	
Aaccb	*Users misinterpreting biased output*	
Aacw	*Whose responsibility to develop means of interfacing with users and when?*	*Aaa*
Aacm	*Identifies commcn media, interface mechnms to manage commcn./lit. constraints*	
Aacmd	*Diff methods for diff people (equitable cf equal modes)*	
	Maps	
	Graphical user interface	
	Tables	
	Surrogate person/trustworthy orgzn	
Aacmt	*Thai cf english DSS*	
Aacmm	*Developing mechanisms/processes*	
Aam	*Miscellaneous*	
Ab	***Re embedded bias***	
Abj	*Lists justifications for trying to minmise embedded bias*	
	To minimise misinterpretations	
	To manage for ignorance	
Abb	*Identifies potential biases*	
	Identifies uncertainties	
	Identifies assumptions	
	Sees problems if DSS doesn't incorporate multiple info.	
	Sees problems if DSS doesn't incorporate multiple perspecs.	
Abm	*Re managing embedded bias*	
Abmf	*Re managing for flexibility/relevance*	*Bcf*
Abmc	*Re communicating uncertainties, assumptions*	*Aac*
Abx	*Perspective infers potential for embedded bias*	

B	CONSTRUING OF THE DSS (AND DSS DEVELOPMENT)	Related themes
Bc	*What should it be/look like?: Desired /intended characteristics of DSS (nature/form)*	*Bu*
Bcr	*Relevant and useful in real world*	
Bcd	*Produces good data*	
Bcf	*Flexible/updateable*	
Bcw	*Widely usable/user-friendly*	*Buo*
Bce	*Equitable*	
Bcx	*What DSS should incorporate/ info. required for DSS*	
Bcxs	*Re how stakeholders views incorporated in DSS*	*Bdp*
Bcm	*Miscellaneous characteristics*	
Bu	*How can/should/will the DSS be used by whom?*	
Buw	*Who should identify users?*	
Buz	*General statements of purpose*	
Buzs	*Broader DSS cf just software info. system*	
	Computer and non-computer information	
	Assist participatory planning	
Buzsp	*Re how DSS interacts with particip. framework/ other policy mechanisms*	
Buzi	*Acquire, organise, coordinate data/information: info. data system*	
	Propose alternatives for development	
	Clarify options/issues	
	What-if simulation to view impacts of diff options	
	Explore/generate better understanding of impacts/consequences of diff options	
	Show pros andcons/costs and benefits/tradeoff diff options (quantitative/qualitative)	
	Determine optimal resource use respecting stakeholder needs and environmental needs	
	Assist more systematic consideration of resource management issues	
	Provide same info/understanding to all stakeholders:	
Buzc	*Reduce/reconcile conflicts, promote political harmony*	
	Promote fairness/justice/equity	
Buzn	*Acquire scientific proof, authority, credibility for negotiation*	
	Improve efficiency	
	Present complex science in format easily understood	
Bur	*Research purposes*	
	Improve researchers' understanding of system	
	Assist research integration	
	Long term memory of project	
	Initiate DSS research	
	Pilot for transferral to other basins	
Buv	*Re villagers/farmers using the DSS*	
	Evaluate biophysical processes	
	Protect environment	
	Sustainable development	
	Understand the state of the environment	
	Acquire authority for negotiation	
Bug	*Re govt.staff usingthe DSS*	
	Technical staff as users	

	Policy advisers as users	
	Tell villagers what to do	
	Efficiency	
Buo	*Other uses/users*	
	Political harmony	
	All stakeholders as users	*Aa*
Bua	*Re adoption of DSS / research dissemination/extn*	*Aai*
	No interest in DSS if position not supported	
Bd	*Re development process*	
Bdm	*Motivations for developing DSS other than Bu*	
	Politics - resources	
	Personal contact	
Bdf	*Factors inhibitng /shaping progress*	
Bdff	*Financial problems*	
Bdfc	*Coordination problems*	
	Equipment problems	
	Technical problems	
Bdp	*Re involvement /partcpn. in DSS development*	*Aap*
Bdr	*Tension betw research project and practice*	
Bdrr	*Tension between research and use*	
Bdrt	*Tension betw technicality and particpn in devlpmt*	
Bdrm	*Tension between manageability and ideal process*	
Bdrp	*Tension betw project timeframe and long term*	
	Tension betw locally relevant and generalizable	
Bdrz	*Tension betw progress and particip approach*	
Bdx	*Miscellaneous re development process*	
Bom	*Other miscellaneous construing of DSS*	
	Re cost of the system	
	Re future of computers	

C	**CONSTRUING OF DECISION-MAKING ENVIRONMENT**	
Ca	*Construing of actors*	
	Construing of particular actors	
	Farmers as uneducated, gullible	
Car	*Re (power) relations between actors*	
Co	*Other construing of decision-making environment*	
	Re decision-making as political	
Cp	*Re participation*	
Z	*Theme code irrelevant*	

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